May 1964

Agriculture

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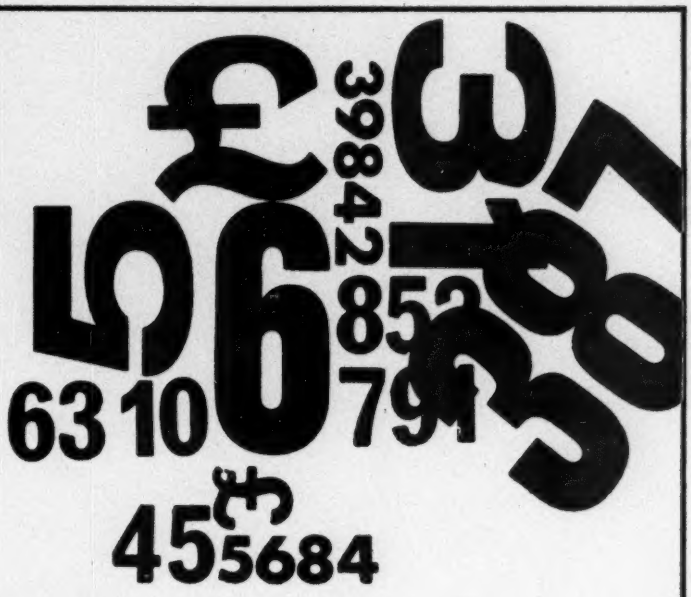

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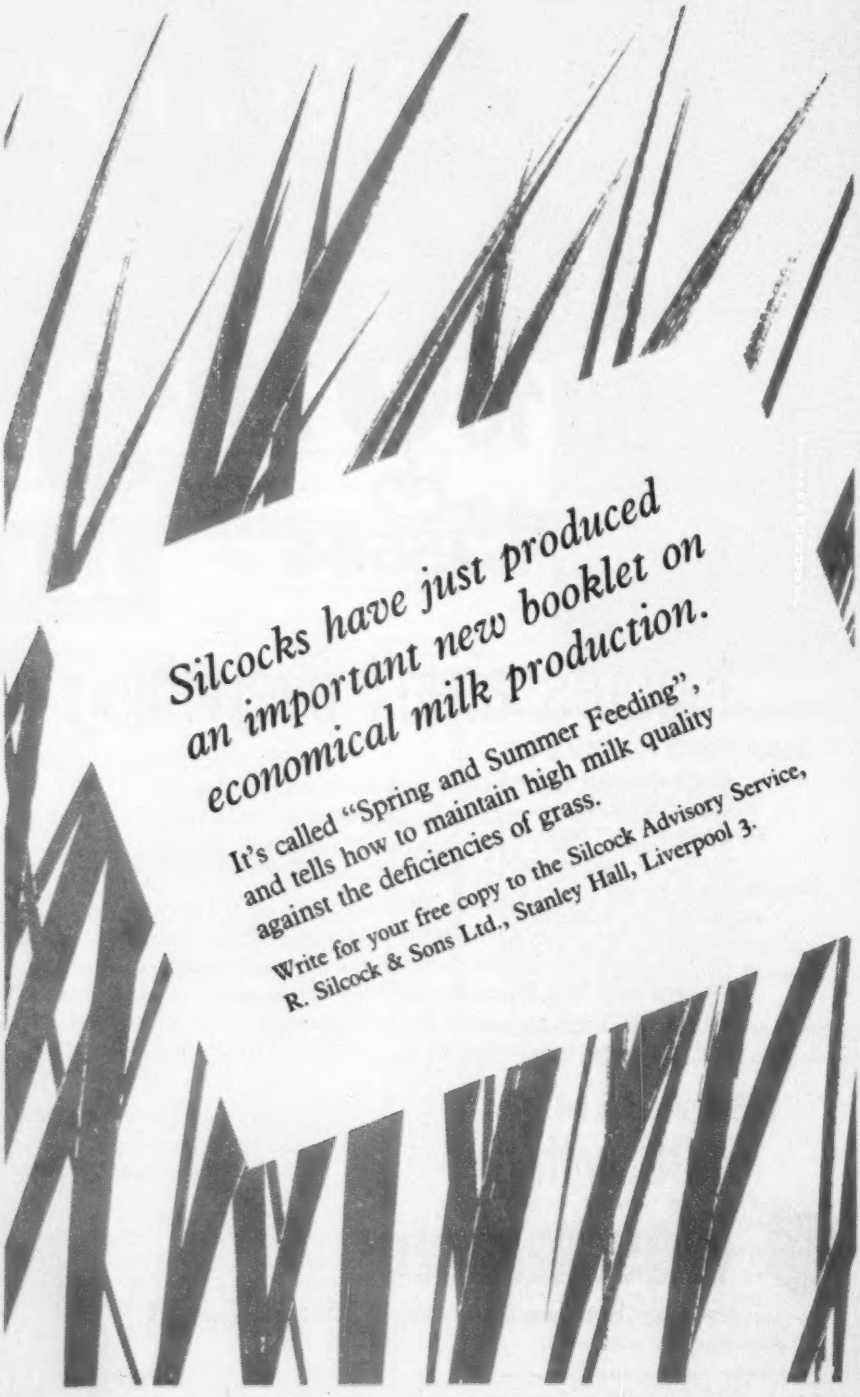
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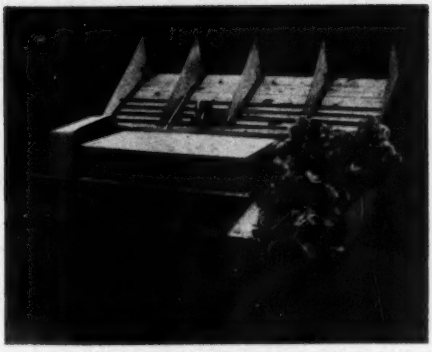
The Critical Approach



This was the new bench provided

'WHAT is achieved?' and 'Need the job be done at all?' are two questions which, superfluous as they may seem, are well worth asking on many a horticultural holding. Transporting materials from one place to another is a case in point where, by using work study techniques, appreciable costs might be saved. This is particularly so of Method Study.

An example: a nursery specializing in chrysanthemums. Twenty people employed in the packing shed for a throughput of 750 boxes per day. Production was to be increased to 1,000 boxes a day and the grower was considering whether to have an extension built on to his packing shed or erect a larger one. On investigation, nearly two-thirds of the labour was found to be handling materials and only one-third actually packing. Six people were handling and papering returnable boxes, which were delivered to packers along a fixed bench down one side of the shed. The packers collected their own flowers and carried the full boxes to a stack at the end of the bench for tying and labelling. The result: congestion.

Following a method study, the whole packing shed was reorganized so that flowers, boxes and materials could flow with a minimum of handling. The fixed bench was removed and a light, mobile packing bench provided for each worker, away from the wall, so that boxes and flowers could be brought to and from the packing bench from both sides. The flowers are brought to the packers and the full boxes transported by roller conveyor to the dispatch point. The low capital outlay enabled output to be increased by one-third.

CO_2 for Glasshouse Crops

A major break-through for glasshouse growers, leading to higher crop yields of better quality

THEORY and PRACTICE explained by

Ron Gardner

As with many other industries, horticulture has entered a very active phase of evolutionary development; and this, it seems safe to assume, will receive additional impetus from the new legislation on horticulture. An interesting example of the kind of change which is occurring in horticulture is the fertilization of the atmosphere of glasshouses with carbon dioxide gas. This is an entirely new development in commercial glasshouse practice, and the aim is to promote photosynthesis and so induce improvements in plant growth which subsequently lead to higher crop yields and better quality.

Scientifically, the idea is not new. The possibilities were proved some forty years ago at the old Cheshunt Glasshouse Experimental Station in the Lea Valley. But at that time practical application was limited by the then uneconomic price level of pure, safe sources of CO_2.

Cheaper sources of CO_2

This situation has now changed. Practically pure CO_2 can be manufactured within the glasshouse by burning a liquid petroleum fuel such as propane. In Holland, paraffin has also been used for the purpose, but in Britain the sulphur content of supplies may be such that sufficient sulphur dioxide may be formed in the course of combustion as to damage the plants. These liquid petroleum fuels provide CO_2 at particularly low cost.

Since the 1920s the pure forms of CO_2, such as the liquid, bought in pressure vessels, or the solid, sold as 'dry ice', have also become relatively cheaper and economically worthwhile. These forms are best used in warm weather, since they do not raise the temperature of the glasshouse. Alternatively, the liquid petroleum fuels appear to have an advantage for use during cold weather, as combustion within the glasshouse, at the rate required for CO_2 generation, raises the temperature of the atmosphere by about 4 deg F. This represents a sizable contribution to daytime heat requirement and therefore partially offsets the cost of CO_2 enrichment.

Large-scale experiments in Britain have been in progress only since the autumn of 1962 and growers have moved with great speed. Equipment has now been installed in many parts of the country. Lettuce, chrysanthemums and carnations are the crops which have been tried most, but all green-leaved crops grown under glass are potential beneficiaries.

Firmer control of environment

As will be shown later, this is a highly promising development and the initial thrust in proving that CO_2 added to glasshouse air can now be used on a commercial scale to enhance crop yields and qualities came from the Ministry's Experimental Horticulture Stations. Subsequently, and to their credit, the raw material suppliers and the firms of horticultural engineers concerned with the manufacture of CO_2 equipment encouraged many trials on horticultural holdings. They have also vigorously undertaken the development of commercial equipment and already, only eighteen months from kick-off, growers are able to adjust automatically the input of CO_2 to the opening and closing of the ventilators of their glasshouses. If he so wishes, the grower can also automate the opening and closing of the ventilators and at such level of temperature as he decides to select; control gear and thermostats are available for the purpose. The supply of artificial heat is likewise controllable automatically, and with the advent of CO_2 the whole environment of the glasshouse, with the very important exception of light, is being brought within precise and automatic control. It is, of course, an economic possibility to provide artificial light to crops in the early stages of growth when many plants can be placed within a small area.

Such is the present picture in the rapid evolution of glasshouse practice. The CO_2 story is a successful example of 'combined operations' between the experimenters, the engineers and suppliers and the growers. If the new legislation for horticulture is to have a full and beneficial impact, similar exercises will have to be repeated many times. To achieve *real* modernization of glasshouses, together with the necessary ancillary equipment, and not just *replacement* of the old, the interest of designers and engineers must be awakened. They will then, as in the case of CO_2, provide the necessary link in the chain between the commercial proving of new ideas on the Experimental Horticulture Stations and rapid acceptance and application by the horticultural industry.

How plants use CO_2

In normal air there is some 0·03 per cent of carbon dioxide; say 300 volumes in each one million volumes of air. In the presence of daylight

The chrysanthemums on the left were grown in an atmosphere enriched by CO_2. Those on the right received no CO_2

or a suitable source of artificial light (but only in the presence of light) green plants assimilate the carbon from this very low concentration of CO_2 and combine it with water to form sugars. This is the process familiar to many as photosynthesis or carbon assimilation.

From these basic facts it will be evident that there will only be a case for enrichment of the atmosphere, with CO_2 above the normal 0·03 per cent level, if the plants can use the additional carbon to increase the synthesis of sugars. It has now been proved that, subject to a certain minimal level of light and to the provision of a high enough temperature during the hours of daylight, when the utilization of the carbon and the synthesis of sugars will be occurring, the plants can make use of extra carbon and will synthesize sugars at a substantially greater rate. For the important qualification of adequate daytime temperature, and for much related information, horticulturists are indebted to Dutch researches at Wageningen and to Dr. P. Gaastra in particular.

The sugars produced within the plant by photosynthesis are utilized for growth and development, and the greater the supply of sugar the better growth becomes, both in quantity and in quality. All organs benefit—roots, leaves, flowers, fruits and seeds. But it must not be forgotten that some other factor in the environment, such as water, or mineral nutrition, or the potential of the chosen variety, may still limit results. The most skilful and painstaking growers are gaining most benefit from the use of CO_2; it is not an easy way out for the unskilled grower.

Experimentally, the increases in yield obtained have varied from about 16 per cent to as much as 38 per cent, depending on the kind of crop, time of year and the variety chosen. On the latter point, investigations at the Lee Valley E.H.S. have shown that the varieties of each crop differ considerably in their ability to respond to CO_2 fertilization; and this seems to be especially the case when light is at a low ebb, as during the winter months. It is for this reason that variety testing, in the presence and absence of extra CO_2, must be given high priority in the next stage of experimentation on the glasshouse stations.

Gains in quality

Thus far only the favourable effects on yield have been discussed, but in many plants quality of product is also highly dependent upon the available supply of sugar. Records made at the Lee Valley E.H.S. show that the numbers of petals in chrysanthemums enriched by CO_2 was higher by 14–20 per cent, so the blooms were finer. Experiments in the U.S.A. on carnations and roses have shown the same trends. The treated chrysanthemums at Lee Valley also remained fresh and bright for several days longer than those untreated; this means better value for the purchaser.

The number, as well as the size, of the leaves is increased, and in the case of lettuce this means better hearted, plumper heads—a vital factor in winning the winter market against competition from overseas.

Application

The right level of CO_2 fertilization for each kind of plant has yet to be ascertained. This also is the case with the level of daytime temperature which should accompany the enrichment. Meantime, and pending further results from experiments, growers have been advised to aim at raising and maintaining the concentration of CO_2 to three times ($\times 3$) normal, i.e., to 0·09/0·10 per cent. This must be accompanied by a positive day-time temperature of about 65°F.

The latter requirement implies raising the temperature by artificial heat on cold and possibly sunless days in winter to 65°F and of using sun heat to the maximum, on days that are sunny. This is done by avoiding the opening of ventilators until the temperature, in the presence of sun-heat, is well above 65°F, and probably up to 75°F for crops such as cucumbers and tomatoes. This is the approximate regime for cool and cold weather conditions. In warm weather the need to avoid damage to plant performance by reason of excess temperature within the glasshouse may dictate that the ventilators be open for much of the day, leading to the escape of the enriched air. Other methods of application are then appropriate. Night temperatures should be a little lower than normal, especially in winter.

Work at the Fernhurst Research Station, as well as samplings made at E.H.S.s, suggests that if pure gas is then used and released from narrow gauge plastic tubes, at low level beneath the canopy of plant foliage, enrichments of 1·5–2·0 normal (0·045/0·06 per cent) may be maintained, with about the same rate of input as described for winter conditions. For this form of application the 'cool' forms of gas seem especially suitable.

The rate of injection required under average conditions of tightness of glasshouse structure and weather condition is about 50 lb of pure CO_2 per hour per acre of glasshouses. This is with ventilators closed and $\times 3$ enrichment as the objective. Where propane is used as the source of the gas and is burnt within the glasshouse, about 17 lb of fuel is required. This is because each pound combines with 2 lb of oxygen to form 3 lb of CO_2.

Higher returns

The amount required per acre will then vary with the length of the day. It is, of course, injected only during the hours of full daylight. At a time of year when eight hours of injection is called for, a weekly consumption of about 1¼ tons will be entailed per acre of glass. On this basis the cost per acre, depending upon the source used and whether bought in bulk or

in small batches, ranges from about £20 to £60 per acre per week. The cost per crop can thus be computed by multiplying the period of treatment in weeks (of stated daily duration) by the price per week, the price being dependent upon source. Capital costs, fortunately, are relatively small; about £250–£300 per acre.

Taking £30 per acre per week as the basis for costing enriched crops grown in the winter, and after making allowance for depreciation, it has been worked out that the improvement in gross margin (in the case of lettuce) was £350 per acre, per crop. And two to three crops can be taken, if desired, from each glasshouse over the autumn/winter season. For chrysanthemums, the gain was reckoned at about £1,080 per acre, per crop. Less experimental work has been done with CO_2 on the tomato crop, but the tentative indications are of an improvement of about £1,500 per acre.

Of vital significance

The fertilization of glasshouse crops with CO_2 is still very much in the development stage, and assessments of monetary worthwhileness must be regarded as provisional and subject to revision as we gain more experience. In the context of the competitive battle between the outdoor producers of southern Europe and the glasshouse industry of north-western Europe, the developments are likely to prove of vital significance.

For the method to be employed at economic costs, it requires a building, such as a glasshouse, wherein the enriched atmosphere can be contained, whilst permitting daylight to reach the plants. Thus the application of CO_2 as an aid to crop growth seems likely to be specifically helpful to the glasshouse grower, and to him alone.

Ron Gardner, N.D.H., formerly Director of the Lee Valley Experimental Horticulture Station, is now in the N.A.A.S. London office as Deputy Senior Horticultural Advisory Officer.

Quote

'The development of cheaper and more efficient methods of rearing livestock, which is such a marked feature of the changes occurring in farming practice, has brought with it very real benefits to consumers. The increase in the consumption per head of poultry meat of 5·1 lb pre-war to 9·4 lb in 1958, and to 14·6 lb in 1962, at competitive prices, is one instance of this. At the same time, these new methods, as they become increasingly widespread, raise the question whether standards as to the general conditions under which these animals are raised and kept should be laid down.

'My Rt. Hon. Friend, the Secretary of State for Scotland and I feel the need for an expert inquiry to advise on this. We have therefore decided to set up a technical Committee to examine the conditions in which livestock are raised and kept under systems of intensive husbandry and to advise whether standards ought to be set in the interests of their welfare, and if so, what they should be.

'I hope to be able to announce shortly the names of the Chairman of the Committee and of its members, who will include officers of our Departments as well as other knowledgeable persons.'

Mr. Christopher Soames, Minister Agriculture, in a written reply to a Parliamentary question on April 20th.

TAKE-ALL
EYESPOT
SHARP EYESPOT
BROWN FOOT ROT
POWDERY MILDEW
YELLOW RUST

THE DISEASE RISKS of Continuous Cereal Growing

H. E. Croxall

Last month Mr. B. Wilkinson discussed the soil aspects of intensive cereal growing. The following article looks at four soil-borne and two air-borne diseases which are risks to be guarded against

CHANGING from a traditional eight- or four-course rotation to continuous cereal production is similar to changing a slow, reliable, family saloon car for a high-speed, sports model. The new car may offer the possibility of getting you there quicker, but much more skill and precision is required if you are to arrive safely. So with a cereal crop. A disease hazard is present at any time but the risk is much greater the more intensified the programme becomes. This is especially true of diseases which can persist in the soil, for these have the maximum opportunity of building up to dangerous levels, while the farmer has the minimum time available for combating them.

The four main soil-borne diseases caused by fungi are Take-all, Eyespot, Sharp Eyespot and Brown Foot Rot.

Take-all

Although Take-all may not be the most prevalent, it is the one soil-borne disease most likely to cause a crop failure. Its most obvious feature is the poorly filled 'whiteheads' present at harvest; in wet seasons these may be blackened by secondary moulds. Poor ears may arise from a number of possible causes, but if due to Take-all there is a characteristic blackening of the base of the straws, often accompanied by decaying roots, so that the plants are easily pulled up. This disease is more damaging to winter- than to spring-sown crops, and wheat is more susceptible than barley. There is a

Blackened areas on the bases of wheat stems and rotting of roots, caused by Take-all. Poorly filled ears from affected plants with the normal ear in the centre. Grain from these heads is shrivelled

special strain of the fungus which attacks oats, but this is rarely found outside Wales. The disease can also be carried on perennial weed grasses, particularly couch, bent and Yorkshire fog. It is most likely to be serious in wet, cold seasons, and is favoured by a high lime content in the soil. Generous nitrogenous manuring in early spring will help the crop to grow away quickly and to stand up to a certain amount of infection.

Eyespot

Eyespot can be recognized by the eye-shaped markings, usually with a darker 'pupil', on the lower part of the stem. The fungus weakens the straw and increases the risk of 'lodging'. It is encouraged by warm, wet conditions, overcrowded plants, and a too lavish application of nitrogen.

The introduction of resistant varieties, especially of winter wheat, has reduced considerably the importance of this disease, but it tends to build up with successive crops.

Sharp Eyespot

The symptoms and effects of Sharp Eyespot are similar to those of Eyespot, though the cause is different. The eye-shaped markings are more strongly defined and have no 'pupils'. There may be several on one straw, the lowest being almost at root level. Severe strains of the fungus may penetrate the stems so deeply that 'whiteheads' are produced like those with Take-all. Although present in many crops, this disease tends to cause serious losses only in crops sown in cold, dry conditions. It tends therefore to be particularly damaging to late (November-December) drilled cereals in a dry winter. The most devastating attacks have been seen in the first crop after either grass or a non-cereal arable crop.

Brown Foot Rot

Brown Foot Rot has become more prevalent in recent years. It is recognized by brown areas at the base of the stem, sometimes with a superficial white mould, and again may be associated with 'whiteheads'. This disease is frequently associated with adverse soil conditions, especially drying out of sandy soils carrying spring barley, bad drainage, or a poor seedbed. At least one species of Fusarium (the responsible fungus) may be carried on the seed and attack young plants, especially under cold soil conditions.

Early stubble break

All these diseases depend largely for their survival in the soil on the presence of infected cereal straw and roots. So the first step is to break up stubbles as quickly as possible after harvest, since the warmer the soil conditions the more quickly do the stubbles rot down. With the complete breakdown of the stubble, the diseases, deprived of nourishment, are starved out. The longer one delays sowing the next susceptible cereal crop, the greater is the chance of reducing the disease to an innocuous level. Successive spring-sown crops are thus less risky than autumn sowings—a fact borne out by the many farmers who maintain high yields from a succession of spring barley crops. The recipe here is to cultivate stubbles immediately after combining, to destroy any seedlings from self-grown grain early in the winter and to control completely perennial weed grasses.

The problem becomes more complicated if the farmer has to include winter cereals in his succession. There is no difficulty if a winter crop precedes a spring crop; the same procedure between harvest and sowing can be followed. The disease risk becomes much greater if one tries to follow a spring cereal, particularly barley, by winter wheat or to grow successive crops of winter wheat. Even if the sequence is started by early sowing of an early-maturing variety, the interval between harvest and drilling the next crop is far too short for safety. Delaying sowing into late autumn gives a longer time for infected stubbles to decay, reducing the Take-all risk, but may involve sowing at low temperatures, favourable for Sharp Eyespot and Brown Foot Rot. Moreover, unless the autumn-sown crop is drilled before the soil becomes cold, it is difficult to get quick germination and establishment of sturdy plants capable of resisting the attack of any surviving disease.

How late a sowing?

There is some information available from experiments on the time of sowing of winter corn, but the difficulty is to apply this to farms in different parts of the country over a very varied range of soil types. A later time of sowing will obviously be possible on a warm, light soil near the coast than on a cold, heavy upland clay. Probably, each farmer must determine for his own conditions how late he may drill and still expect good yields: as a rough guide, it is suggested that on the more difficult soils the farmer should aim at getting his winter corn drilled by the end of September, while in

Eyespot lesions on base of wheat straws, showing eye-shaped areas with darker 'pupil' in centre. Stems are weakened and tend to break easily at these points

more favoured situations it is probably safe to go on drilling for at least another month, depending on how quickly temperature falls in the autumn.

The risk with successive winter cereals, particularly from Take-all, can be reduced if winter oats are introduced into the cropping sequence; though this is possible only if there is no eelworm problem. The golden rule is that a highly susceptible crop should be followed by a more resistant one, so that the sequence should be wheat, barley, oats. Winter oats may also be grown after spring barley to get back more safely into an autumn-sowing sequence. Finally, there is a big advantage in limiting the length of the cereal sequence by moving a small acreage of either ley, roots or legumes round the farm. Then if there should be a build-up of disease in one field it can be kept in other crops for two years to restore it without drastically changing the acreage in corn.

Powdery Mildew

Large acreages in a single crop, which is an integral part of an intensive system, provides a big target for air-borne spores to alight on, and once established there are no barriers to halt the progress of a disease. It is therefore imperative to try to avoid such an attack. The most dangerous of these air-borne invaders are Powdery Mildew and Yellow Rust. Mildew is a disease of warm, dry conditions and thus tends to be most devastating on late-sown spring crops which have made little growth before the weather is warm enough for a rapid build-up of the fungus. Spring barley and spring oats are likely to suffer most, though occasionally winter oats are badly affected. It is therefore important to drill spring barley and oats before the end of March, especially on light soils.

Yellow Rust

Yellow Rust is most dangerous to winter wheat, particularly after a mild winter. The disease may then pass to spring-sown crops and can seriously reduce the yield of susceptible varieties. Fortunately, plant breeders are now providing high-yielding varieties resistant to both these diseases. But there are no grounds here for complacency, since sooner or later the fungi produce new races which can attack the resistant varieties. Farmers must be looking for them continually, and as soon as a variety shows signs of breaking down in resistance he must switch to newer resistant varieties. He is helped in this by the National Institute of Agricultural Botany, which publishes yearly lists of recommended varieties showing their resistance or otherwise to the important diseases.

No farmer can eliminate the disease risk from intensive cereal growing, but he can reduce the hazards to an acceptable minimum. Good cultivations, precise timing of all operations, efficient use of fertilizers, correct seed rates, and taking full advantage of resistant varieties must all play their part. In a few words: the better the farmer, the less the risk.

H. E. Croxall, B.Sc., Ph.D., F.I.Biol., is Plant Pathologist in the West Midlands Region of the National Agricultural Advisory Service. He previously served in a similar capacity in the North Region of the N.A.A.S., before which he was Advisory Mycologist at the Long Ashton Research Station, Bristol. Dr. Croxall is particularly interested in assessing disease losses and the economics of control measures.

An old wagon lade serves as a creep hurdle

A profit margin on summer grazing of £68 per acre, obtained in a N.A.A.S. study on an ordinary small Cornish farm, emphasizes the possibilities awaiting small farmers who are prepared to run sheep intensively

Money in Sheep

G. J. F. Stevens

SURELY many small farmers should consider the financial advantages of running sheep intensively. This thought comes naturally into the mind after a little exercise which the N.A.A.S. carried out in Cornwall last year, with the co-operation of Mrs. Boundy and Son of Lopthorne, near Bude. The farm comprises 94 acres and carries 14 beef cows, 28 other cattle, 60 breeding ewes and 29 acres cereals.

Over £100 per acre output

The majority of farms in Cornwall are small, and the average gross margin of £17 per acre obtained from the traditional rate of stocking of 2¾ ewes per acre is much too low to cover the unavoidably high level of fixed costs.

Where conditions are not suitable for dairying a sheep enterprise can be quite attractive, with often a hundred per cent return on capital. The risk factor is low because the capital is divided into a large number of units. Little capital has to be tied up in buildings, and the product and the capital are realizable more or less at any time during the year, since sales can be made of breeding, in-lamb or cull ewes. Couples make a ready trade in the spring and summer, and often in Cornwall the market for store lambs for finishing to heavier weights on rape and autumn grass is as good as that for fat lambs. The wool probably forms the most easily marketed farm product.

The field selected for the study on Mrs. Boundy's farm was five acres of new seeds undersown in the spring of 1962 and had carried no sheep prior to stocking in April, 1963. It was divided into six equal plots by fencing posts and sheep netting. Provision was made for a creep for the lambs between pens by using a movable hurdle made out of an old wagon lade. The total cost of materials, including some second-hand sheep netting, was £50.

Towards the end of February, 3½ cwt per acre of a high nitrogen complete fertilizer was applied. Immediately after the first grazing 1 cwt of 21 per cent Nitro-Chalk was put on to each of four plots and ½ cwt after grazing to the other two.

Altogether 48 Devon longwool and Devon longwool cross ewes and their lambs were brought in, the ewes remaining in each plot for three to four days. A Suffolk ram was used on the flock.

MANAGEMENT DIARY

March 12th	Lambing commenced
April 5th	30 ewes and 43 lambs introduced to paddock No. 1
April 22nd	Additional 17 ewes and 22 lambs introduced to paddock No. 6
May 7th	Additional 1 ewe and 2 lambs introduced to paddock No. 3, to make 48 ewes and 67 lambs in all
End of May	Lambs dosed with Frantin
June 5th	One paddock cut for silage
Mid-June	Ewes shorn
July	Lambs shorn
August 25th	Lambs were weaned and taken from the paddocks and dosed with phenothiazine. The ewes remained.
September 2nd	30 additional ewes added to the paddocks to prepare them for flushing
September 21st	All ewes removed for flushing. The sward in the paddocks was left with a dense bottom.

The ewes were overwintered mainly on silage, which proved invaluable during the six weeks of snow and frost. To encourage initial creeping, the lambs were given food in troughs. Water was also provided. Generally, the fact that the ewes were confined to a limited acreage and always under control was a favourable feature of the system.

Six lambs were lost, due to balling of fibre in the rumen caused by an anatomical weakness.

Sixty-one lambs were removed from the paddocks on the 25th August. Two-thirds could have been sold fat, while the remainder were mostly in very forward condition. An additional result of the study was that elsewhere on the farm increased acreage of cereals was grown and better than average provision for the other stock was made for the coming winter.

Returns from 5 acres intensively stocked with 48 ewes and their lambs

Costs	£	Receipts	£
Concentrates		61 store lambs @ £6 10*s.*	396
Lambs: 2 cwt @ 30*s.*	3		
Ewes: Silage and concentrates @ 20*s.* per ewe	48	48 fleeces @ £2 17*s.*	137
		Wool from lambs	24
Ewe Depreciation			
48 × 40*s.*	96		
Fertilizers			
High nitrogen C.C.F. and Nitro-Chalk	21		
Miscellaneous Costs			
48 × 15*s.*	36		
Proportion of Additional Fencing			
$\frac{1}{5}$ of £50	10		
MARGIN	343		
	£557		£557

Margin per acre £343 ÷ 5 = £68 per acre devoted to summer grazing

Margin per ewe £7

This account allows for all the variable costs incurred by the ewes, except that for late autumn and winter grazing, which will reduce the final gross margin per acre devoted to sheep. Nothing has been credited for the small acreage of paddocks cut for silage. It should be remembered that on many farms stubbles are available for wintering ewes, and no great charge can be incurred in cleaning up the pastures overwintered with sheep.

Ten ewes to the acre

To sum up, although the field selected was rather exposed, of only ordinary fertility level and the grazing took place after a particularly severe winter and spring, it successfully carried nearly ten ewes to the acre and provided a margin over food, fencing, fertilizer, direct miscellaneous and depreciation costs of £68 per acre for the summer period. Although only two-thirds of the lambs were fat at the end of the period, had these been drawn out earlier a greater portion might have been removed fat. At the outset it was primarily intended to provide as many store lambs as possible for fattening out to heavy weights on rape for the winter trade. In view of this the results were singularly successful.

G. J. F. Stevens, N.D.A., is the Ministry's District Advisory Officer at Bude, Cornwall. He studied at Seale-Hayne Agricultural College and, after farming for a time, joined the National Agricultural Advisory Service in 1949.

How do liquid fertilizers compare with the more usual, solid forms of fertilizers?

Liquid Fertilizers

T. H. Caldwell

Sprayer suitable for applying liquid fertilizers direct to the soil

LIQUID fertilizers were introduced into farming some ten years ago, when irrigation techniques were developed* but the corrosion which they caused to equipment militated against their use. This problem has now largely been overcome by the use of special alloys or anodized surfaces. A further renewal of interest has come in some areas with the establishment of local manufacturing plants.

*Their use in horticulture dates back twenty years or so.

Various types of 'nutrients in solution'

The term 'liquid fertilizers' tends to be used rather loosely to describe a whole range of different types of solutions containing nutrients; and this can lead to confusion. Let us, therefore, define the main types:

FOLIAR SPRAYS. These are weak solutions containing small amounts of nutrients and are applied direct to the growing crop.

LIQUID FERTILIZERS. These consist of solid fertilizers dissolved in a small amount of water. Mainly they are applied direct to the soil. In contrast to the weak foliar sprays, they can be used to supply sufficient nutrients to last throughout the growing season. They are thus used for the same purpose as solid fertilizers.

GAS LIQUOR. This is a liquid by-product from gas-works, usually containing about 2 per cent of nitrogen, present largely as ammonium carbonate and ammonium chloride with some free ammonia. Occasionally some phosphate or potash fertilizer is dissolved in the liquor, so giving a compound type. Gas liquor is usually applied at the rate of about 300–400 gallons per acre, but it has to be used with care, since it can scorch growing crops. It is best applied to the bare soil well in advance of sowing. It is also frequently used on grassland by farmers near the larger sources of supply, but for grass it should be applied in the dormant period in winter.

LIQUID MANURES. These are of animal origin and consist of urine or urine plus washings; and semi-liquids or slurries containing various proportions of urine, faeces and washings. More and more of these materials are becoming available following the increase in intensive systems of keeping livestock and poultry. Until now, liquid manures in this country have usually been regarded as being more of a nuisance than as a means of supplying useful nutrients to crops. But abroad liquid manures are valued for their organic matter and nutrients, and special trouble is taken to collect and use these materials. There is no doubt that greater attention will have to be paid to liquid manures in this country and the investigations being carried out to find the best means of using them in areas where there are large supplies. As a rule, liquid manures are applied to grassland or, on arable farms, to the bare soil in advance of sowing the crops so as to avoid scorch damage.

The place of nutrient foliar sprays

The aim is to provide conditions for intake of nutrients through the foliage, and this is achieved by application of the spray, often under pressure, using sprayers with very fine jets which 'atomize' the spray. Coverage and wetting of the foliage is further improved by the addition of a spreading agent. Although plants can quickly absorb and utilize nutrients applied in this way, the foliar spraying technique has only a restricted value in this country. In the first place, crops must grow to a stage when there is sufficient foliage that can be sprayed, and very often this stage can only be reached by applying fertilizers to the seedbed. There is little point, therefore, in withholding some of the seedbed application so that a spray can be applied later on. If nitrogen is needed during the growing season it is usually satisfactory to apply this as a top dressing of solid fertilizer. Apart from this difficulty of waiting until there is sufficient foliage, only small amounts of nutrients can be applied safely to foliage. The amounts of nitrogen, phosphate

GUIDE TO FOLIAR SPRAYS

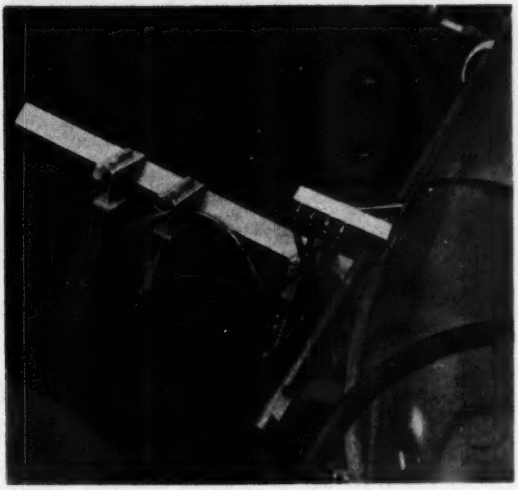
Nutrient	*Weight of Material*	*gallons/ac*	*Crops*
Major Elements			
Nitrogen	20 lb urea	100	cereals, beet, grass
	10 lb urea	100	other crops
	5 lb urea	100	fruit
Phosphate	20–25 lb triple super	40–100	arable crops
Potash	20–30 lb sulphate of potash	40–100	arable crops
Magnesium	40–60 lb Epsom salts	100	cereals, beet, brassicae
	20 lb Epsom salts	100	other crops
Trace Elements			
Manganese	5–8 lb manganese sulphate	25–100	arable crops
	3–4 lb manganese sulphate	100	fruit
Copper	2 lb cuprous oxide or copper oxychloride fungicide	50–100	cereals
Boron	4 lb sodium borate	25–100	beet, turnips, swedes, kale and cauliflower

A wetting agent to facilitate spreading of the spray over the leaf surfaces should be incorporated in all these sprays.

and potash that can be used are only sufficient quite often to stimulate the crop for a short time; their effects usually fade in two or three weeks.

There are a few occasions nevertheless when it is useful to apply a foliar spray of a major nutrient. If, by mistake, insufficient phosphate or potash has been applied before the crop is sown and deficiency symptoms appear at an early stage of growth, then a spray application can often save the crop. Top dressings of solid fertilizers of phosphate and potash seldom act quickly enough to be of much value for a short-term arable crop. A nitrogen foliar spray can also be of some value when applied to a crop in a period of long

Injector system for the placement of liquid fertilizers into ridged land



Driver's view of mid-mounted injector, showing the straight tines used for brassica and sugar beet crops

drought and the top soil is so dry that a dressing of solid fertilizer could not act in time. However, a nitrogen spray will provide only a slight stimulus and cannot act fully unless the crop eventually receives adequate moisture from the soil.

In contrast to the limited value of major nutrient sprays, there is no doubt that the foliar technique is very useful for remedying trace element deficiencies. It is of particular value for the control of manganese deficiency in a wide range of crops; treatment via the soil is much more expensive and very often less efficient. Foliar spraying is also an excellent way of correcting copper deficiency in cereals, though application of copper to the soil can also be used. Early treatment of boron deficiency by foliar spraying is satisfactory, although it is more usual to apply boron direct to the seedbed.

The place of liquid fertilizers

Liquids can be sprayed on to the soil or injected by suitable equipment into the top soil much more accurately than can be achieved by broadcasting or placing solid fertilizers. With crops such as potatoes, where placement is a more efficient means of using fertilizers, liquid fertilizers can be handled more easily.

Applying solid fertilizers after sowing the crop is not always the best means of using fertilizers, as the nutrients may not reach the roots of the crop for a long time, especially in a very dry soil. Spraying a liquid fertilizer on the surface of the soil after sowing will be rather similar in effect, for the liquid will not contain sufficient moisture to wash the nutrients into the soil. On the other hand, it is possible to inject liquids successfully for row crops after sowing the crop, and experiments are at present in progress to study the effects of delaying application of fertilizers for a short period after the crop has been sown. If it proves possible to achieve good results by delaying injection of fertilizers for up to say two weeks after sowing, then this could be of value on farms where there are large acreages of row crops and where sowing the seed need not be delayed.

Liquid fertilizers have been used successfully for top dressing cereals and grass but, because of the concentrated nature of these solutions, the aim, in contrast to the use of nutrient foliar sprays, is to minimize wetting of the foliage in order to reduce leaf-scorch. Liquid fertilizers when used for top dressing must therefore be applied at an early stage of growth, using sprayers with large jets. A spreading agent should not be used.

Contract services or hiring

Farmers interested in using liquid fertilizers have the choice of contract services or hiring the necessary equipment. These fertilizers are made from urea, ammonium nitrate, ammonium phosphate and muriate of potash dissolved in a small amount of water. We know from experiments that the same materials in solid or liquid fertilizers give very similar effects when they supply equal quantities of plant foods.

A range of liquid compounds can be made by combining various amounts of the chemicals, but a limit in concentration is set by the solubility of the fertilizers. One cwt of present-day liquid fertilizer can contain at the most a total of around 30 units of plant food (N, P_2O_5 and K_2O)—for example, a 10%N 10%P_2O_5 10%K_2O liquid fertilizer. The highly concentrated range available as solid compounds, where 1 cwt can contain a total of around 50 units of plant food—for example, a 20: 15: 15 compound—cannot be achieved with liquids. Thus a greater weight of liquid fertilizer has to be handled to supply the same amounts of nutrients as a highly concentrated solid compound. For example, 1½ cwt of liquid 10:10:10 compound provides the same amount of nutrients as 1 cwt of a 15:15:15 solid compound.

Under a contract service there is no storage or handling of sacks of fertilizers, and the liquids can be delivered by tanker direct to the field and stored there in returnable plastic tanks. Contract application of the liquids can also be arranged. This type of service could be attractive on some farms where there is a shortage of labour, particularly on very large farms where bulk handling with liquids is simpler than with solids.

On the whole, liquid and solid fertilizers give very similar effects when they contain the same nutrients. If, as at present, prices per unit of plant food supplied are also similar then choice of a liquid fertilizer, instead of a solid type, will depend on other factors such as the farm labour supply, whether there are many row crops for which placement of fertilizers is used and whether the load of spring application of fertilizers can be lightened by using liquids for spreading the period in which fertilizers can be applied.

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On a Wirral farm higher profits are earned with a lower output

Simplification Pays

Alec Calder

THE Ashfield Hall Estate consists of three farms owned by J. Johnson and Sons, Liverpool Potato Merchants, and run by Mr. Karl Jennings. In all there are 570 acres of fertile soil, which includes 200 acres of reclaimed Dee marshland on which there are no buildings apart from a single Dutch barn.

Ten years ago the farming system was one of complicated mixed cropping and stocking, traditional in this area. The business was founded on equally complicated economic foundations. All three cereals were grown: the wheat for sale, the barley for feeding to pigs, and the oats for feeding to the cows and followers. There were two dairy herds of 50 cows each. Followers were reared both for herd replacements and for sale. There was also a flock of 120 pedigree Kerry ewes for fat lamb production.

Enterprises reconsidered

Here is an analysis of the several enterprises:

CEREALS

Yields average but high proportion of oats made for low output.
Decision: Replace oats by barley. Increase yields by using better varieties and more fertilizer.

POTATOES

Output satisfactory, but casual labour rising in cost and becoming scarce.
Decision: Discontinue this crop.

COWS

Milk sales averaged 700 gal per cow, but concentrate use was found to be 5 lb per gal for every gallon produced.
Decision: Steps to be taken to improve the enterprise by placing greater reliance on home-grown foods and modernization of buildings.

PIGS

Output lower than the direct costs involved.
Decision: Abandon this enterprise, which would allow a further reduction in the labour force.

SHEEP

Output satisfactory, but increasing competition with the cows for spring grass.
Decision: Discontinue the enterprise.

As regards overheads, the cost of labour was high, though not excessively so having regard to the complexity and intensity of the business. The machinery costs were also heavy by reason of the variety of machines required for the mixed farming system.

Reorganization

It was decided to simplify the farming system and concentrate on corn and milk production. Such a move would allow large reductions in labour costs and, over a period of time, in other overheads such as machinery.

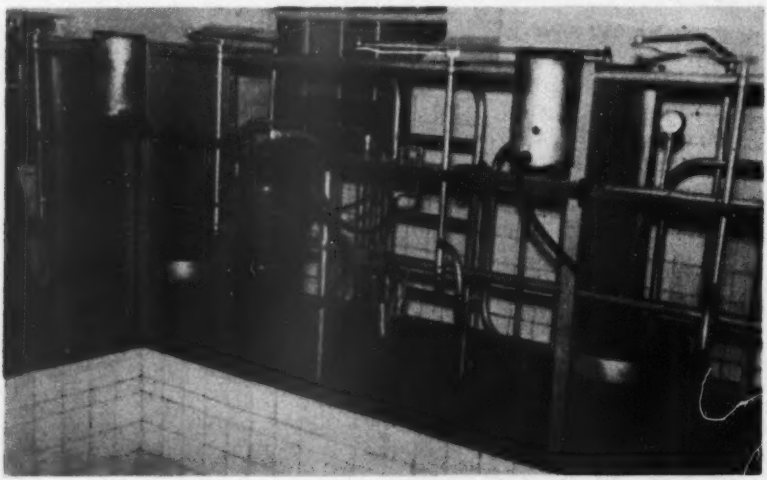
Dairy followers were cut out. Cereal growing made more profitable use of the land than rearing replacements. The latter could be bought fairly easily. Each dairy herd was increased to 60 cows and the traditional single-rank shippons were converted into yards and parlours with attached self-feed silos. The labour requirement for each herd was halved. One man has easily managed his 60 cows where two men were previously required for 50.

As experience was gained in the technique of making large quantities of high quality silage, so was the quantity of concentrates fed to the cows reduced. From a figure of 5 lb per gallon, concentrate use has now dropped to practically nil—without any loss in yield. The milk is in the top band so far as quality payment is concerned.

With no concentrate feeding, there was some difficulty in getting the cows into the parlour, but this was overcome by the use of an electric 'dog' in the collecting yard. A treacle dripper has also been installed over each milking point so as to feed a more palatable mineral ration.

The margin per cow of milk over concentrates has increased from £60 to over £100 as a result of these changes. And this has been achieved without any reduction in the traditionally high stocking rate. Additional nitrogen has been used to grow the amount of grass required for self-feed silage. These improvements have resulted in the gross margin of the cow enterprise being increased from £35 to £51 per acre.

Inside the four-point walk-round milking parlour.
The treacle drippers over the feed troughs ensure a more palatable mineral ration



Grain is tipped from a trailer into an auger for elevation into bulk store

Corn-growing has been fully mechanized on a bulk handling basis, and all of it is now sold. Floor storage is provided for the full acreage of both wheat and barley. Conditioning is by means of electric fan and ducting. Three men can now harvest the 370 acres of grain with one large tanker combine. By way of higher yields and the facilities to store over winter, the gross margin on the wheat crop has risen from £34 per acre to £46.

Farm profits doubled

Ten years ago the labour force was twelve men plus casuals for potatoes and harvest. Today six regular men suffice to carry out all the work on the three farms and casual labour has been eliminated. Because the evolution has been gradual there has been no redundancy of farm staff. As workers have left for various reasons, they have not been replaced.

The gross output of the farm was previously over £34,000. As a result of the reorganization output has fallen to £29,000. To carry out the modernization programme, £8,000 capital has been put in for the yard conversions and the grain storage installation. By cutting out the unprofitable enterprises and reducing the fixed costs by specialization, farm profits have more than doubled. The return on the extra capital injected has been of a very worthwhile order.

By economic analysis and cost control through simple farm records, Mr. Jennings has shown that simplification can lead to greater profits with a lower gross farm output.

FIGURES FOR COMPARISON

Crops and Stock	*10 years ago (acres)*	*Today (acres)*
Wheat	135	150
Barley	90	220
Oats	40	—
Potatoes	40	—
Grass and kale	265	200
Cows	100	120
Young cattle	70	—
Ewes	120	—
Sows	40	—
Pigs fattened	560	—

Seven farms in BERWICK ST. JOHN, WILTSHIRE,

point the way to economic farm integration

Farmers of this Parish

'As individuals we wouldn't have an economic unit. We have to do the job together'

J. E. B. Pocock

Ralph Whitlock

MR. A. R. L. AYLWARD, the Hampshire farmer who launched the first farm machinery syndicate in 1955, started something bigger than even he could have foreseen. Originally these syndicates were concerned only with making available to a group of farmers machinery and equipment which individually they would have been unable to afford. Now there are well over 300 of them, and they have been used not only to acquire equipment ranging from hedge-cutters and rotary cultivators to huge grain-drying installations but latterly to explore the possibilities of co-operation in livestock production. I myself have detailed plans for a pig-breeding syndicate, and others are working on the implications of similar ventures with beef.

Seven farms work as one

Even more far-reaching are developments in the little Wiltshire village of Berwick St. John, near Shaftesbury. There, around a series of syndicates, the most important of which has installed a £16,000 grain-drying plant, a pattern of co-operation which is rapidly approaching integration is being evolved for the seven village farms.

The syndicate members are Mr. J. E. B. Pocock, the chairman, Mr. R. S. Walby, vice-chairman, Mr. G. B. Grant, Messrs. H. J. Follett and Son, Messrs. W. T. and E. Follett, Mr. T. Hall and Mr. E. C. Bartlett. Between them they farm about 2,250 more-or-less continuous acres, on which certain factors favour co-operation.

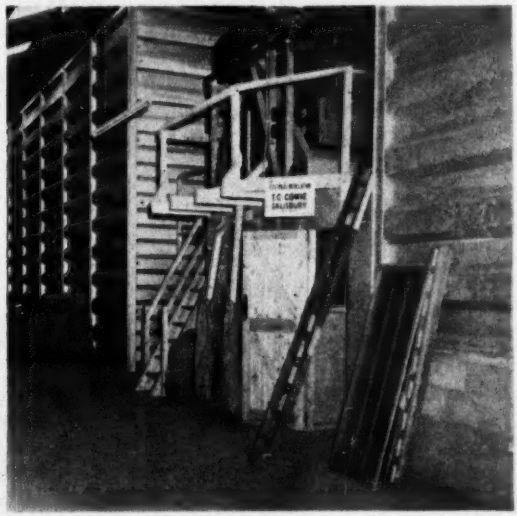
For instance, the village lies in a deep basin, its upper slopes of chalk, its middle zone of greensand and its bottom land of heavy clay. In early spring the chalk soils are cultivable and ready for sowing often several weeks before implements can touch the valley fields. The tractor force of the village therefore starts work on the chalk and works downhill, the entire array sometimes operating in one field—a quite impressive sight. Says Mr. Pocock, 'It does relieve tension if you can get on drilling someone else's land when your own is too wet'.

Another factor is that all these farms are approximately of the same size economically. They range from 180 to about 600 acres, but the smallest has a large dairy herd, which tends to even things out. In some respects they are complementary. Mr. Pocock concentrates on corn growing and running sheep on his grassland, which includes a fair bit of sheep downland. Mr. Hall's 180-acre dairy farm consists mostly of strong soil in the valley. Therefore Mr. Hall runs his replacement stores on Mr. Pocock's hills, thus leaving his own better bottom land for cropping. Mr. Hall bales Mr. Pocock's hay and straw and buys most of the straw for litter for his herd. Mr. Pocock, for his part, does seed drilling for Mr. Hall and Mr. Grant, with Mr. Walby lending and borrowing implements as occasion arises.

A third contributory factor to success is that all of these farmers are in the same age group—all in the prime of life and most of them with small families. They are keen, alert and progressive enough to appreciate the advantages of co-operation.

Grain drying plant and storage

The idea of the grain-drying syndicate, their major effort to date, was conceived in January, 1962. One of the members offered a site, plans were prepared and work began at the end of May. It was still in the finishing stage when the year's harvest began to flow in.



In this photograph of the £16,000 grain-drying and storage plant at Berwick St. John, the drier is in the centre with a nest of 16 storage bins in the background, each capable of holding 32 tons of barley

The reception pit for damp grain is divided into three sections, each connecting with one of the pre-drying silos. This enables the harvest of three farmers to be dealt with separately and simultaneously

The installation is one of the most modern in the country, consisting of a Penney and Porter drier, a No. 8 Turner cleaner, an Alvan Blanch weigher and the necessary elevators, together with a nest of 16 storage silos and three pre-drying reception bins. Each silo measures 8 ft × 10 ft by 20 ft high, and holds 32 tons of barley, the total capacity thus being 512 tons. After harvest is over the three reception bins can also be used for storage, so bringing the total to about 600 tons. The plant is housed in a concrete and asbestos building of magnificent dimensions—113 ft × 56 ft by 18 ft at the eaves—which gives ample accommodation for a further 250 tons of grain, either in sacks or loose on the floor. So far the drier has had to deal with the produce of about 600 acres of cornland, but it should be quite adequate for the 1,000 acres to which it is hoped shortly to increase.

A commendable feature of the installation is that the reception pit is divided into three separate bays, each connecting with one of the pre-drying silos. This enables three farmers to bring in their harvest simultaneously without danger of confusion.

Costs divided by seven

Total capital cost of the machinery was £5,500; the buildings, including the grain silos, £10,265. On the latter the Ministry gave a grant of one-third, so reducing the total by £3,421. The site cost £324, and the syndicate was thus involved in a total expenditure of £12,668.

Syndicate Credits (Wiltshire), Ltd., financed the whole scheme. It asked for an initial deposit of 20 per cent, with the rest payable by annual instalments over seven years. There is a service charge of 1 per cent on the amount borrowed, and interest, paid only on the outstanding balance each year, is at 1½ per cent above the bank rate. A little simple arithmetic will reveal that

if the seven farmers took up equal shares*, each would acquire his share of this impressive establishment by the payment of about £350 down and an annual payment of just over £200. At the end of seven years, when fully paid for, it will still be a very valuable asset. The building has been designed to allow a switch to be made to some other enterprise, such as beef, should corn growing become unprofitable.

Running costs for 1962 amounted to about £300 for fuel oil and electricity, and to meet them syndicate members were charged 18*s.* 6*d.* per ton for drying and storage. As the plant is operated by the members themselves, no charge is made for labour.

What next?

Now that the grain drier has dealt with the most difficult harvest of the century—a harvest which in the 40-inch rainfall of Berwick St. John dragged on till the middle of October—the syndicate farmers are contemplating what they should do next. Communal ownership of the means of dealing efficiently with grass is high on their list of priorities. Some of them would like to form a syndicate to acquire forage harvesters. They are also considering the joint ownership of combine harvesters and the installation of a central petrol and fuel depot for the seven farms.

Though so far the Berwick St. John syndicate is probably unique in including *all* the farms in a parish, thus creating a sizable agricultural block almost entirely within a ring fence, it may well be a pattern which will be widely followed. Mr. Pocock is convinced that it will be. 'It's the small farmer's only alternative to becoming a tractor-driver for his larger neighbour,' he declares.

A leaflet, produced for a joint field day, showed how Berwick St. John, with its total population of 286, produced annually 30,000 dozen eggs, 250,000 gallons of milk, 600–700 tons of grain, enough fresh meat to keep the city of Salisbury (population over 35,000) supplied for a month, and enough wool for 1¼ miles of best Wilton carpet. And the people of this little village knew that, far from being a piece of clever arithmetic, these figures really did represent a communal achievement in which they all had a part.

* They probably did not; the usual arrangement is to relate the share holdings to the corn acreage of each member. *R.W.*

CHEESE, SIR?

English, of course!

Mary Phillips

A bit o' Cheshire

THE Cheshire plain is one of the rich grazing areas long associated with the production of cheese on the farm, as are similar areas in Somerset and South-West Scotland. As long ago as the fourteenth century, this association of good grazing lands with the best cheese was appreciated, for, in his description of the counties of England, John Speed (1542–1629) the historian and a native of Farndon in Cheshire, refers to the county of his birth:

If the affection to my naturall producer blind not the judgement of this my survey, for aire and soile it equals the best, and far exceeds her neighbours, the next Counties. The soile is fat, fruitfall and rich, yielding abundantly both profit and pleasures for man. The Champion grounds make glad the hearts of their tillers; the meadowes imbroidered with divers sweet smelling flowers; and the pasture makes the Kines udder to strout to the paile, from whom and wherein the best Cheese of all Europe is made.

As the product of a living animal, milk is extremely variable in composition and it is likely that territorial types of cheese were developed originally to suit the milk of a particular locality. It has often been suggested that the presence of salt under the Cheshire pastures has a bearing on the type of cheese made.

Today there are still over forty farms in Cheshire and North Shropshire making Cheshire cheese and, although the number is reduced compared with pre-war days, the four million pounds manufactured is no mean quantity.

On some farms the cheese is still made by a member of the family, but even where a cheesemaker is employed, it is usual for the farmer or his wife to supervise the making.

Apart from the introduction and use of the lactic acid culture (starter), the basic method of making appears to have changed little during the last hundred years. As in the manufacture of any product, the quality of the raw material is of paramount importance, and I think it would not be extravagant to claim that the chemical and bacteriological quality of the milk used for cheesemaking is the factor which controls the final product, no matter how skilled the cheesemaker may be.

Prior to the second world war, cheese was made to fit the pattern of summer milk production. In fact there is still a tendency to do this today on some farms; others, as a result of the emphasis on winter milk production being required during the war-time food shortage, now make the whole year round. This has necessitated extra care and expense in the temperature control of making, pressing and ripening rooms in winter.

Cheshire cheese is sold in two forms—red and white. The red kind is produced by the addition to the milk of an orange-coloured vegetable dye (annatto).

The perfect cheese

Mr. Richard Mullock, of Waverton, in a paper on the Cheshire cheese industry read in 1909, described the modern ideal Cheshire cheese as 'outwardly as firm as an apple—colour, bright and clear—texture, rather open, rich or velvety, neither close, sticky nor crumbly—flavour and smell, clean and sweet, more nutty than cheesy—taste, neither sickly sweet nor salty to the palate, neither greasy nor leathery, and ready to be eaten in eight weeks, and not too ripe or spoiled in as many months.'

Whatever this adds up to, he further observes, 'But not one-tenth comes up to this ideal!'

The same observation could be made today of the cheese coming from Cheshire farms, not because the majority of cheeses are of poor quality but rather that there is ever a striving after a higher ideal—the perfect cheese which must be clean in flavour, bright in colour, firm in texture and yet have a 'break' so that, according to Miss Bennion, who has done so much to help Cheshire cheesemakers, 'it spreads on the biscuit but does not fall off!'

This may sound a trifle lyrical but 'proof of the pudding is in the eating'—an old adage that was confirmed in a recent survey which showed that 90 per cent of the shops selling cheese stocked Cheshire.

So much is eaten so new now, that ripening is seldom allowed to proceed and produce the unique and wonderful flavour of a mature cheese. This is a far cry, alas, from the tribute of a Scotsman, who in 1886 said: 'It is still true that a fine old Cheshire cheese a year and a half old, mellow and blue-veined throughout is simply unbeatable as an Epicurean treat.'

Miss Mary Phillips, B.Sc., N.D.D., is Regional Milk Advisory Officer at the West Midlands headquarters of the National Agricultural Advisory Service, Wolverhampton. After graduating at the University of Reading, she worked at the Cheshire School of Agriculture and later at Cannington in Somerset. She then did advisory work on milk and Cheddar cheese before moving to Wolverhampton in 1958.

Over 500 an hour with two men

Handling Sheep on Waterhouse Farm

R. E. Howse

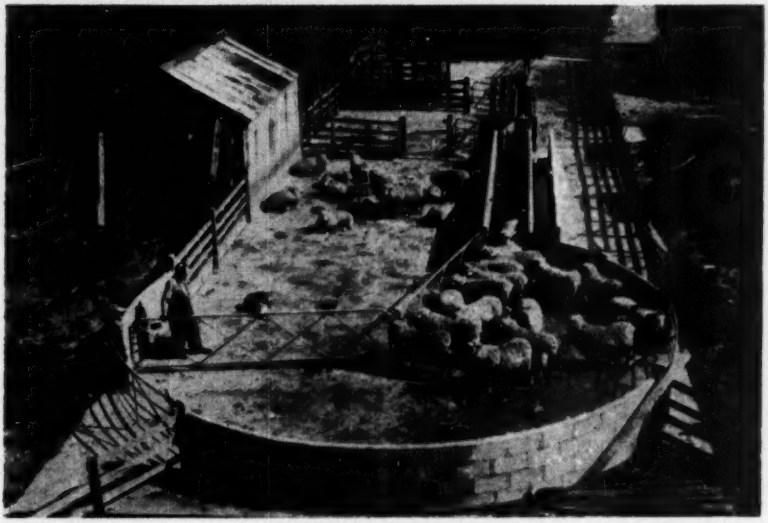
SOME people say our methods of handling and dipping sheep are the same as they were a hundred or more years ago. This may be true in a few instances but, like most sweeping assertions, it denies too much and credits too little. Take, for instance, the handling pens and procedure which the Ashbys have introduced on their Waterhouse Farm at Appledore on the Romney Marsh. Designed by the son, Keith, and built by him and the farm handyman, the outfit handled over 1,600 sheep in three hours at dipping time last July, with just two men and a drover. At other times the layout requires just one man and a dog working behind the mesh gates.

The outfit is sited on open ground adjoining the main through farm road, and all techniques for handling a flock of any size have been incorporated. It is generally considered that sheep move better uphill, so this site has been given a rise of about 1 in 60 from the edge of the circular forcing pen to the end of the draining pen. In this case it also gives the sheep a clear view of the skyline and pastures ahead, all of which helps to make them run well. Such a site, with the right type of gates described later, avoids the additional expense of decoy pens at tactical points to keep the sheep moving.

The whole of the handling area—102 ft long by 27 ft wide—is surfaced with concrete (one part Portland cement, two parts sand and four parts aggregate) and is hand-tamped. All the draining pens are laid to fall, so that liquid passes between the race and the dip and foot-baths into a catch-pit, whence it eventually returns to the bath. The important point to note here is that the liquid re-enters the bath behind the sheep.

Combined crush and bath

To save valuable land, the crush and dipping bath are combined. The walls of the bath are constructed of 9 in. concrete blocks to floor level and are continued in 4½ in. concrete blocks to a height of 3 ft 1 in., to form the sides of the crush and one side of the foot-bath; the other side of the foot-bath is of similar blockwork. All concrete blockwork is to British Standards



An aerial view of the sheep handling pens and dipping bath at Waterhouse Farm, taken at a special demonstration

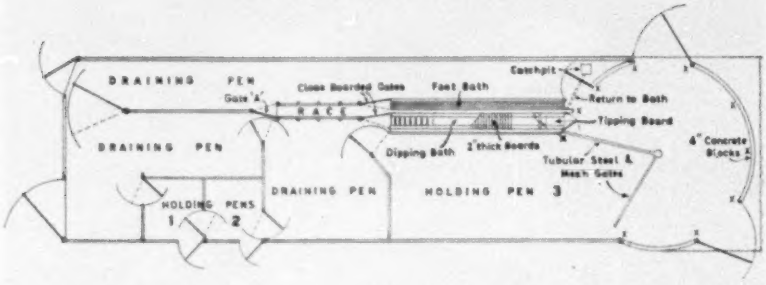
Specification B.S. 2028. The whole of the blockwork in the dip-bath, the crush and the foot-bath is rendered smooth to assist in waterproofing and also to prevent fleece damage.

For the first 8 ft the boards of the removable floor of the crush run longitudinally and are supported by 2 in. tubes, spaced at approximately 4 ft centres. This is because the offset at the point where the thickness of the walls is reduced, is chamfered to an angle of approximately 45 deg to make sure that sheep entering the bath do not hit their shoulders on a square edge. After the first 8 ft, where the square shoulder does not matter, 2 in. boards are placed across the bath and form a race when the bath is not in use. These boards are not tongued-and-grooved; they are butt jointed so as to fit tightly together lengthwise but have sufficient end play for easy removal.

The crush is 2 ft 6 in. wide. This measurement is critical, since it allows a man to handle sheep comfortably and, at the same time, is not wide enough to allow other sheep to pass. The length of the crush and bath is 26 ft 9 in. Where the sheep enter the bath it is 6 ft deep; the bottom is sloped to a depth of 4 ft 4 in., where a stepped ramp helps the sheep to get out. The steps are placed centrally on the ramp, with a 2 in. gap between the step and the vertical wall to assist draining. At the point of entry there is a hinged tipping board and under this a plastic float, which permits a sheep to drop gently into the bath and returns immediately into position to receive the next animal. The dip-bath is 20 in. wide.

When dipping, the sheep are funnelled from the forcing pen. A roller fixed to the corner of the left-hand wall prevents jamming. This roller is permanently fixed to a piece of 3 in. by 3 in. timber, which is drilled to receive bolts, and the concrete block wall is also drilled and ferruled, so that the roller can be quickly and easily removed when not required. There is no drain-off point in this bath. The dipping fluid is pumped out into a tanker and taken away to a safe place for disposal.

GENERAL LAYOUT OF PENS



x—fastening positions for sweeping gates

Alongside the combined crush and dip-bath is a 26 ft foot-bath. A guide wall is set 1 ft 4½ in. away from the crush wall, with the 12 in. foot-bath placed centrally. The top edges of the bath are bevelled to meet the vertical walls. Longitudinal ribs formed in the base concrete of the foot-bath ensure that the sheep keep their feet in the liquid and that the liquid reaches the cleft of the foot.

Into the race

The layout incorporates a 12 ft long race, which is 13 in. wide at the bottom and 16 in. wide at the top. It is made of timber, with 3½ in. by 3½ in. posts set at an angle at approximately 4 ft centres. On the inside it is close-boarded from the top to within 3 in. of the bottom, with ⅞ in. boarding planed smooth; all nails fixing the boards are punched well home. The race is set 5 ft away from the crush and foot-bath.

The sheep are guided to the race by close-boarded gates that control entry either from the foot-bath or from the crush. At the exit of the race and on the centre line is a fence dividing two pens. The distance between the fence and the race is 3 ft 2 in. and, by the use of a special gate at this point, the sheep can either be held in the race or drafted two ways. Thus the sheep have to pass through the race in single file, and here they can be sorted or given individual treatment over the fence.

The perimeter walls of the circular forcing pen are constructed of 4½ in. concrete blocks, with two 9 ft gateways, one on either side of the pen. The gates serving these openings are all of tubular steel and curved to complete the arc when closed. From the hanging post of each of these gates runs a funnel fence on each side, in order to guide the flock into the pen. There are two tubular forcing gates, clad with heavy gauge wire mesh, hung on a central steel post. The gates are fixed to the tubular post with ringed hinges, each provided with a grease nipple, so that both gates operate smoothly and quickly. These forcing gates and all other gates on this piece of equipment are provided with spring-loaded catches, the control arms of which project above the gates for quick operation.

The boundary wall has metal plates with ferrules at eight more or less equidistant positions, so that the swinging forcing gate can be held fast in any one of these positions. Similar fixings are also put on each side of the crush, so that either the crush or the foot-bath can be used; one gate acts as a funnel while the other sweeps.

Foot-bath and draining pen

The gate between the perimeter wall and foot-bath, which is used for closing the foot-bath, is close-boarded, like the gates leading from the crush. Apart from these three, all other gates are either of the mesh or slatted type, so that the sheep can see through them.

In the draining pen areas there are two small holding pens, which are used for dagging and foot rot operations so keeping contaminated matter to a confined area and facilitating clearing up.

The boundary fencing and divisional fencing is of the typical Romney Marsh pattern, constructed with oak posts and oak arris rails. It is claimed that this particular type of fence has so far never been known to trap a ewe.

Smooth operation

Even this layout, however, can run into unforeseen difficulty. During the dipping operation last year, after a number of sheep had been put through the bath and the liquid draining from them started to flow back between the race and the dip-bath, it was found that the rest of the flock were inclined to shy at the sight of the returning trickle; and this, of course, slowed up operations. Two sacks laid on the concrete, immediately by the exit, overcame the trouble.

A few days after all dipping had been completed, the bath emptied and the floorboards replaced to form the crush, there was no sign of reluctance by the sheep to go through the crush—which might have been expected had they remembered the bath.

Seen in operation, I am convinced that this method of sheep handling would impress many flockmasters, since the whole operation is carried out quickly, smoothly and with very little labour.

A new edition of F.E.F. Leaflet No. 14, *Sheep Handling Pens and Baths*, has just been issued, price 1*s.* 3*d.* (1*s.* 6*d.* by post) from H.M. Stationery Office.

The author of this article, **R. E. Howse, B.E.M.**, is an Assistant Land Commissioner in the Ministry's Agricultural Land Service and is stationed at Maidstone. He specializes in farm buildings.

E. I. Prytherch

The Pembroke Earlies

Irrigation in the spring

THE flourishing early potato industry in South Pembrokeshire has its roots in the pioneer work of the mid-1920s. Reporting on the very cold early summer of 1923 and the consequential low prices for early potatoes, the County Agricultural Organizer at the time foresaw '. . . that farming would be more remunerative in South Pembrokeshire if efforts were made by local farmers to increase the acreage of this crop.' Today there are nearly 9,000 acres devoted to earlies in this area. The formation of an association of early potato growers was also mooted in the early days, but it was not until almost forty years later that such an association was formed.

That a large proportion of the county is not suitable for growing early potatoes has been well established, and factors influencing the earliness of bulking have been closely studied and understood. The growers are specialized producers and realize the practical importance of keeping abreast of new knowledge. Indeed, in a highly competitive industry they well understand that they cannot afford to be out of date in their husbandry practice.

The seed itself

Practically the whole of the seed is bought, and this is particularly the case after a season when the market has absorbed the early ware. The value of healthy seed is recognized, and the main sources of it are the hill country of North Pembroke, the Brecon and Radnor area, Northern Ireland and Scotland—all cool, humid and windy districts.

Seed produced in these areas has a low percentage of virus infection. Grade 'A' seed is generally a minimum requirement of health. This largely explains why eelworm has not become a hazard, despite the very high intensity of potato cropping. ('SS' and 'A' grade seed can only be produced in England and Wales on land found to be free of potato root eelworm.)

In the main the varieties grown are Arran Pilot, Home Guard and Craig's Royal, but there is an increasing interest in Arran Comet, which seems to show a very favourable rate of bulking.

The seed is 'boxed' as early as possible in the autumn in the usual glass chitting houses. The tubers remain dormant for a period, and the extent of dormancy varies between one variety and another as well as on other factors such as the date of lifting the crop. One or two sprouts per tuber is the main aim, and seed which breaks dormancy soon after harvesting will normally produce fewer sprouts than seed of the same variety which starts to sprout later.

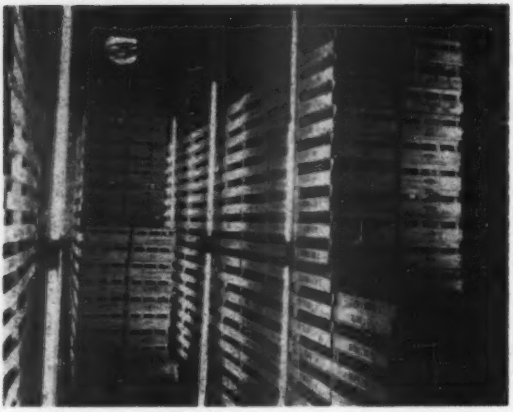
During recent years seed has been sprouted in converted barns and other buildings using artificial light instead of daylight. Another development has been the setting-up of a store where the environment, through refrigerated cooling, can be kept under complete control to produce the desired one or two sprouts per tuber and the appropriate size and sturdiness in the sprouts themselves.

Growth control

An exceptionally noteworthy development in recent years is the application of water to keep the rate of growth moving at a steady pace. Growth is naturally determined by the availability of soil moisture, and this in turn by the amount of rainfall and its distribution. Irrigation, supplementing this rainfall, has received considerable attention within the last two or three years, and today no fewer than 80–90 irrigation plants have been installed, with a capacity to irrigate upwards of half the acreage grown.

Crops are first irrigated when the tubers are about pea size. Water loss in a growing crop is at the rate of $\frac{1}{10}$ inch per day in May, which means that with ten days without rain there is a deficit of 1 inch of soil moisture. This deficit justifies a start with irrigation to bring the soil moisture back to field capacity. A rain gauge is very necessary to guide the grower in the frequency of water application. Generally an inch of water is given at the first irrigating, followed by another inch about ten days later if soil moisture conditions so warrant. The economic benefit from a satisfactory operation of the technique is in the order of 2 tons extra yield per acre, or £60 extra gross output.

The manurial requirements of the early ware crop are different from those of the longer growing main crop or crops grown for seed. Experiments in Pembrokeshire over the years have indicated that the right kind of quantities for N, P and K are in the order of 100 units nitrogen, 120 units phosphate



Sprouting in progress under artificial light. A good arrangement o, boxes and lights

and 120 units potash. Too heavy a dressing of nitrogen tends to delay the rate of bulking, with loss of earliness for the first liftings.

Perhaps the most recent development is the interest in the use of chemicals for the control of weeds in the early ware crop. This feature has been stimulated by an appreciation of the loss of soil moisture and soil temperature that takes place during normal inter-row cultivations, together with the damage such operations can cause to the root systems by the severing of side roots. Two types of chemical are marketed for use in potatoes: (1) a contact pre-emergence herbicide, the success ot which depends on the weeds emerging before the crop, with little further germination after spraying, and (2) a contact and soil-acting pre-emergence herbicide. This material or mixture of materials will control weeds which have developed foliage, as well as destroy weed seeds as they germinate. A great deal of investigation is still in progress.

Lifting

To produce a marketable crop at around the 3-ton-per-acre yield is a general aim amongst growers for the first 'diggings'. Price, however, has a major influence on this, in that when prices are high and the demand good, some growers will lift at 2½ tons or even less. The earliest liftings are usually achieved at about twelve weeks from date of planting. The crop bulks at a remarkable speed during this early lifting period and yields per acre may be doubled within one week. The rate of growth varies, of course, according to the weather.

As the season advances prices drop as increased supplies come on to the market. Generally a point is reached when it is more economic for the grower to cease lifting and aim to produce a higher yield per acre to maximize his gross output.

An improvement is taking place in the presentation of the crop for market. Growers rely mainly on gang labour for lifting and this provides an opportunity for grading on the field. Potatoes are then packed in half-cwt branded paper sacks which have been designed and developed by the local potato growers' association for its members. This makes for a very attractive product on the market and the potatoes also appear to retain their condition very satisfactorily in these packages.

The challenge of the future

The Pembroke early potato industry has developed rapidly. New knowledge has made its mark. But with efficient production there must be an effective system of marketing. This is a further challenge to the newly-formed early potato growers' association in the county, and I have little doubt that they will meet it with the same success as has attended their assiduous husbandry.

Evan I. Prytherch, B.Sc., N.D.A., is Regional Crop Husbandry Adviser for Wales in the National Agricultural Advisory Service. A native of Carmarthenshire and a farmer's son, he was brought up on a 300-acre dairy and sheep farm, where he spent six years in active farming after leaving school. He was Deputy County Advisory Officer for Breconshire before taking up his present appointment at the N.A.A.S. Welsh headquarters at Aberystwyth.

New editions of three booklets just issued by the ELEY GAME ADVISORY SERVICE will be welcomed by our readers

GREY SQUIRRELS

The most economic way of controlling grey squirrels is by pre-baiting and cage trapping. Where other pests are involved the tunnel trap has a dual role, for it is excellent for grey squirrels as well as for the keeper's traditional enemies. A recent development is the use of plastics in a new trap. Drey-poking and shooting are also described.

PARTRIDGE REARING

No one should now hesitate to rear partridges in brooders; it is easier than pheasant rearing by the same method. Rearing under bantams is almost foolproof. Recent developments concerning coccidiostats and antibiotics are also referred to.

ENEMIES OF GAME

The trapping of foxes, badgers, wild cats, rats, hedgehogs, moles and wild mink. Also reference to isolated cases of rats having resistance to warfarin, and notes on the Animal (Cruel Poisons) Regulations, 1963.

All are free from Fordingbridge, Hampshire.

Machinerywise

***T. W. Dalton,** Farm Mechanization Adviser*
Cumberland and Westmorland, talks about

Making Hay

(not necessarily when the sun shines)

In the north of England, and particularly the north-west, the grass crop predominates. Properly managed, it is of excellent quality, due mainly to the frequency of summer rain. Grazing presents no problem but haymaking can be a difficult business.

Traditionally our farmers were good haymakers, but a lot of hand work went into the job—tedding, making small foot cocks, shaking out, making larger cocks and finally pikes.

Today labour is scarce and heavy fertilizer applications on more productive leafy strains of grasses have multiplied yields. Drying the heavy swaths of sappy material is really difficult, but it can be overcome by the use of modern machines and techniques.

First, consider mowing. Crops should be cut when dry and the weather forecast is good. Cutting can be done quickly, provided mowers are in good condition with sharp knives and ledger plates. Except in awkward fields, 12–14 acres can be cut comfortably in an eight-hour day.

Cutting in 'lands' avoids bunching and trampling at corners, and it helps the operation of the conditioning machinery as well as the baler. 'Land widths' should not be guessed but measured to ensure that they work out evenly. Where silage is also made it is a good plan to clear the headlands with the forage harvester for silage, but in any case it is an advantage to cut and clear six or eight outside swaths first.

Treatment of the crop should begin during mowing, or immediately afterwards. Mid-mounted and some rear-mounted mowers can operate with another power-driven tool. This applies especially to crimpers, as the modern single-row tedder gives best results at 8–10 m.p.h. rather than a mowing speed of 4–5 m.p.h.

Swath 'fluffed-up' to provide ventilation

Crimping must be done at the same time as mowing, or certainly within half-an-hour. If delayed the bruising effect on the leaves and stems is reduced because the crop becomes tougher as it wilts.

Tedding is more effective if the swath is first turned, especially if a crimper is not being used. Where a turner is not available, an inner swath-board fitted to the mower will turn both sides of the swath; this helps the tedder considerably. The main function of the tedder is to 'fluff up' and disarrange the swath so that air can pass freely through it. After all, the best hay is made by a good breeze rather than hot sunshine. During the first thirty-six hours 'bash' the crop about as much as possible. If it rains the swath will quickly dry and be far ahead of an untreated one when the weather clears up.

Treatment must be more gentle as the swath gets drier and nearer baling, otherwise there will be a considerable loss of valuable leaf.

Flail forage harvesters may be used for direct cutting or for tedding, but not for both operations on the same crop. A careful watch must be kept on the amount of chaffing, which could cause serious loss.

Crimped material will make a day ahead of that which has only been tedded, and tedded will be at least a day ahead of any left for the top to dry before tedding starts.

Quick making reduces risk and improves quality, so it is wise to use the best techniques with the best machines you can afford.

16. South-East Durham

D. Pearce

COUNTY DURHAM is relatively small in agricultural area, but it shows considerable variation in physical features such as soil type, degree of urbanization and other influences bearing on agricultural activity.

In the south-east of the county the changes in topography, contour, soil texture and even aspect are less extreme than in the county as a whole, but they are substantial enough to cause changes in farm type and policy over very limited distances. The farmer of south-east Durham has to adjust his outlook and his enterprises to the conditions imposed on him by the mining of coal, the quarrying of limestone and the growing conurbations which surround him.

The area lies between the 500 ft contour to the north-west and sea level in the south-east. The western boundary follows approximately the line of the Great North Road (A1) where it crosses the river Tees at Blackwell Bridge near Darlington, to the cathedral city of Durham, 20 miles to the north.

The area bordering the river Tees, which forms the southern boundary from Darlington to the North Sea, is well wooded, less exposed and shows greater agricultural prospect than parts at higher altitudes. The Tees estuary forms the coastal edge of the area, which is mainly salt marsh giving way to better agricultural land around Hartlepool. To the north, between Hartlepool and Durham, the land rises quickly to about 400 ft and is dissected by glacial valleys exposing outcrops of limestone. This area also carries the scars left by the coal-mining industry, and although its altitude makes the harvest about a week later than in the Tees valley, the rainfall is only about 25 inches a year.

The basic geology of the whole of the south-east district can be simplified into three main divisions. Strata of Millstone Grit sandstone occur to the north-west, overlaid eastwards with a depth of up to 600 ft of Permian Dolomite. This, in turn, is overlaid with a considerable depth of Triassic sands, pebble beds and marls forming a crescent around the mouth of the Tees. The whole of the area has carried glacial drift which has been eroded to expose the gritstone and limestone in limited areas.

The Millstone Grit has given rise to free-working potato soils near Durham, but much of the parent rock is overlaid with impermeable clay and requires careful and thorough cultivation.

Rich seams of coal underlie the limestone strata and deep mining is traditional south and east of Durham. Pitfalls are not uncommon and occur on some of the better limestone soils south of Coxhoe at Trimdon, Cornforth and Bishop Middleham. Here the farming is generally mixed and on traditional lines. Medium-sized dairy herds (15–20 cows) are maintained on mainly grass holdings while there are mixed arable farms on the lighter soils, with sheep or dairying, together with potatoes, barley and some winter wheat.

A large proportion of the farmers are tenants of the National Coal Board, the County Council or the quarrying companies, but there are a few owner-occupiers and private owners. Many rear dairy or beef stores and carry small beef feeding units, fed traditionally or for 'barley-beef'.

East and south of Sedgefield, the countryside is more open and less steeply undulating and the climate slightly less severe. Farms are more substantial in size and equipment, with expanded corn growing and provision for drying and storing of grain. A lively interest is developing in the sealed storage of barley. Traditional arable rotations with a swede break are still practised on the heavier land, but there is a quickening movement towards a corn/grass policy in many instances and attempts at continuous barley growing are being watched with interest. Very good crops of wheat are grown after ley or potatoes.

At Sedgefield, Greatham and Thorpe Thewles the farms are on better working soils and are more easily adapted to a ley or arable system with sheep and beef, and much of the alluvial land on the north bank of the Tees gives similar free choice of management.

The limited suitability of the area as a whole for intensive cash root growing is shown by the relatively low acreage of potatoes, (3,000) compared with the total acreage of corn (36,000). The swede acreage (2,330) is almost as high as that for potatoes.

There are 65,000 acres of temporary and permanent grassland out of a total area of 110,000 acres of crops and grass, and this emphasizes the importance of livestock enterprises to farmers in this part of Durham County. The figures may also suggest a measure of conservatism in facing present-day realities.

There are almost 7,000 cows and heifers in milk, mostly in herds of 20 or less. Several yard-and-parlour layouts have recently been installed and there is a slow but pronounced movement towards larger one-man units.

Rearing and feeding cattle exceed 30,000 head and are predominantly Aberdeen-Angus crosses or Friesian type. Hereford cross Irish feeding cattle may account for up to 10 per cent of this number. The Shorthorn is tending to lose ground, even though it was at Barmpton and Ketton, near Darlington, that the brothers Robert and Thomas Colling made their name with Shorthorn cattle.

Of the 25,000 breeding ewes in the district, a high proportion (25–30 per cent) are draft Swaledales. These can be managed economically to give a further two crops of lambs on lowland farms before going for slaughter. The remainder of the breeding ewe population consists largely of Halfbreds (Border Leicester × Cheviot) and Mules or Greyface (Hexham Leicester × Swaledale). Some close folding of ewes on leys is practised but most flocks are managed on the extensive mixed grazing principle.

It has recently been announced that more industrial development will be encouraged on this part of the north-east coast. But in spite of the conflicting interests, the farmers of south-east Durham manage to make a worthwhile contribution to our national agricultural production.

F. W. HOLDER
Agricultural Land Service, London

The Bull Pen

DESPITE the increasing use of artificial insemination, the bull is still essential and although fewer farmers are keeping bulls, correct housing for them is no less important.

The farm bull is an important member of the animal community, besides being often the most valuable. It is reasonable, therefore, to provide proper accommodation for him. His size, weight and uncertain temperament make it essential for his quarters to be substantially built; anything flimsy or of 'short-life' is inviting trouble.

In common with other livestock, the bull is entitled to protection from weather, reasonable space for exercise, food, water and a comfortable place in which to sleep. Where a paddock is not available for exercise, the bull's quarters normally consist of a house and an enclosed paved area or 'run'. The house may take the form of a separate building or be part of an existing one.

The bull is inquisitive by nature. He likes to be among people or other animals and, in the case of the latter, he prefers the female of the species. Plenty of activity around him and a sunny sheltered site keep him interested and prevent the boredom which is most frequently the cause of bullish misdemeanours.

If a new bull box is to be built, it must be substantially constructed of good hard brick or solid concrete block. Bulls have been known, in their moments of boredom, to wear away soft brickwork by rubbing it with their horns. Nine inches is the safe minimum thickness for the outer walls of the bull box. Walls should be finished on the inside with a smooth washable surface. Floors and roofs should be insulated for comfort and the roof should be high enough to be safe from damage by the animal. Where possible, a feeding passage within the pen provides shelter for the bull's keeper and makes a convenient fodder store. Access to the bull's quarters should be designed for maximum safety. Sliding doors or gates which can be operated from the outside are generally found to be most suitable. Mangers and fittings should be so arranged that feeding and watering can be done from outside the box, and the fittings should be firmly bedded in and surrounded with concrete

so that the bull cannot get his head underneath and dislodge them. In order to give reasonable comfort and ease of movement, the dimensions of the bull box should not be less than 12 ft × 15 ft. Anything smaller is likely to make difficulties for the keeper or for the veterinary surgeon if he is required.

Where a run or exercise yard is to be provided, it is better to have it rectangular rather than square, with internal dimensions of approximately 24 ft × 15 ft. It should face south or south-east to attract as much sunlight as possible and have a concrete floor with a non-slip surface, laid to falls for efficient drainage. The wall enclosing the run should be of solid brick or concrete block at least 9 in. thick, and should be not more than 3 ft 9 in. high so that the bull can look over it. Tubular steel rails should be provided over the top of the wall to a height of not less than 5 ft. These rails should be spaced at intervals of not more than 6 inches so that the bull will find it difficult to get his horns between them and lever them apart.

The rails should not be less than 2 in. internal diameter, securely fixed to vertical steel or reinforced concrete supports 6 ft apart which, in turn, should be carried down into foundations below ground level. To try to fix these rails to brickwork is merely to court disaster; the bull will push them over very quickly.

The provision of escape gaps is a controversial subject. Whilst they certainly help the farmer or his workers to get away from the bull, at the same time they are a tempting and dangerous means of access for small children and dogs. A modern tendency is to dispense with these gaps and, instead, to place safety rails diagonally across all corners of the run so as to form barriers behind which escape over the wall is possible.

It is common practice to have a service pen adjoining and accessible from the run and from the outside. The pen should be wide enough but not so wide that either the bull or cow can be injured by overbalancing. Whether a service ramp is also necessary is debatable. In some quarters it is thought to introduce an element of danger during service, and for that reason the practice is falling into disuse.

It cannot be stressed too strongly that everything about the bull pen must be 'king-size'. Strong, thick walls, stout railings, thick doors with solid hinges and fastenings; everything, in fact, designed to resist the violent impact to which the building may be frequently subjected. It is false economy to skimp or do things on the cheap. Not only will the bull damage his abode, but he may damage himself, and this may well be the worse of the two evils.

IN BRIEF

Cubicles for Bullocks

The cubicle system has much to offer dairy farmers, particularly those who live in areas where straw is scarce. Can it also help beef farmers who wish to economize in litter? Recent trials at the Grassland Experimental Station in Northern Ireland suggest that it can.

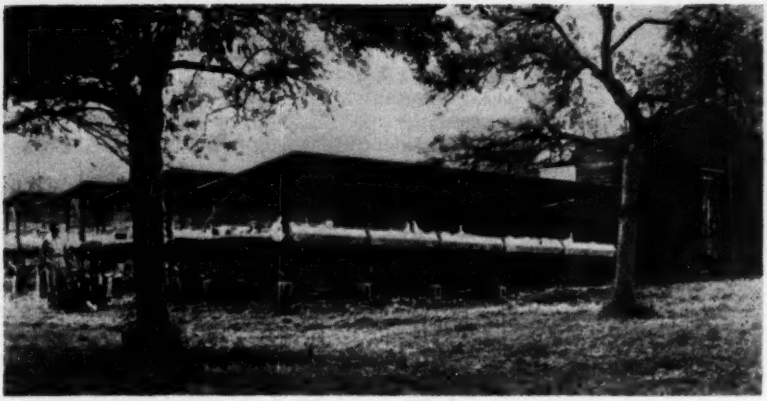
In the winter of 1962–63, sixty bullocks at this centre were housed in a strawed yard and another sixty in a cowhouse converted to the cubicle system by farm labour at a cost of £2 per cubicle for materials. The bullocks in the cubicles, all around 6½–9 cwt, took a few days to settle into their new home. Once settled, however, they appeared to be very comfortable and were considerably cleaner than those in the yard. But whereas the bullocks in cubicles needed only small amounts of sawdust for litter, the yarded bullocks took some 25 shillings-worth of straw per head.

Mr. J. H. Bailie, the Farm Director of the Station, concluded from this trial that bullocks could be housed successfully in cheap and simple cubicles and that the saving in bedding would soon repay the initial cost.

The cubicles were 6 ft long and 2 ft 9 in. wide centre to centre, and consisted of a free-draining lying area separated from the passage behind it by a concrete heel block. The lying area was built of a 4-inch layer of stones covered by 1½ in. of broken stone sheeted with screenings to give a total depth of stone of about 6 in. A 3-inch layer of sawdust was spread on this floor and topped up when necessary. The heel block was 1 ft wide, 9 in. high at the front and 8 in. high at the back, with drainage vents at intervals to carry liquids to the passage from which the slurry was removed daily. The divisions between the cubicles consisted of a single tubular rail running from the wall to the floor in front of the heel block. The height of the rail at the wall was 36 in. above the level of the ground and 27 in. above the level of the sawdust.

The winter's experience suggested one minor modification in this design, for it was found that some bullocks were able to stand along the heel block and reverse into the cubicles so that dung fell on the lying area. It was therefore suggested that either the tubular division should reach the outside of the heel blocks or that the heel blocks should be reduced in width to about 9 in. and given a great outward slope.

Nigel Harvey



A Novel Verandah

Peter Horne farms at Shurdington, near Cheltenham. Looking to the future, he came to the conclusion that his brooder capacity was insufficient for his future commitments. But he hadn't enough money to buy more brooders, so he decided that unorthodox methods would have to be used. To build his own seemed the obvious way out, but his ability as a carpenter didn't match up to his skill as a chick-rearer. A slotted angle construction seemed to him to be the answer.

With fresh orders flowing in to contract-rear stock, he decided to add verandahs to his existing converted army hut brooder house, which would more than double the capacity. The verandahs are constructed by making up the ends and intermediate sections, all of which are of the same dimensions. The whole is joined by members running the length of the verandahs. The slotted angle (together with bolts) comes from the manufacturer, cut to the lengths specified, so it was just a question of simple and quick assembly.

Each section is 8 ft wide, and there is one at every 5 ft of verandah length. Each verandah consists of five such sections, giving a total length of 25 ft. The sides have weld-mesh bolted to them above the mash hoppers, which not only saves wood frame for securing wire netting but also adds rigidity to the whole structure. The floors are of 1 in. × 1 in. slats, nailed to 2 in. × 2 in. framing. They drop into place to rest on the cross-members of the sections and so are easy to remove for cleaning; they are not secured in any way.

Along each side are galvanized iron feeders of the tip-back to fill type. These run the full length of each side of the verandahs and so give a total of 50 ft of feeding space for 200 birds. Mr. Horne thinks this is ample for growers up to at least 20 weeks of age. An 8 ft long pig trough is slung on the end to provide a drinker. At the brooder end a new type of drinker is being tried. This consists of ordinary 1 in. Alkathene piping secured to the side horizontally. Holes are cut on the top so that the birds can drink. Cleaning is done by using a pull-through of lighting flex.

The birds are started off in the brooder house at day-old under electric heaters and at 3 weeks have access to the verandahs. Gradually they are weaned off heat and, when old enough, are pushed through into the verandah and shut out. Mr. Horne does not like moving birds—this for various reasons but chiefly because it is a tedious, time-consuming job that, with proper organization, is unnecessary.

No extravagant claims are made that the system is unique, or cheap. In point of fact, on material it is dearer than wood, but it is much easier to construct and therefore cheaper in man-hours—a very important consideration nowadays.

J. T. Jones

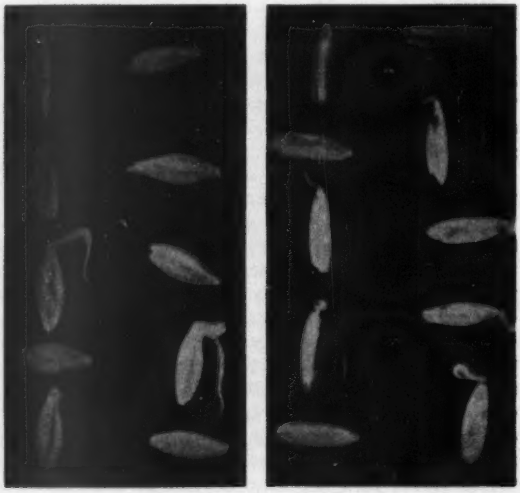
Compass-Conscious?

Seed placement in relation to the compass has been the subject of study at the Canadian Department of Agriculture's Lethbridge Research Station. Their tests have shown that Chinook wheat, Compana barley, Victory oats, common fall rye, and Redwood flax all germinated faster and grew more in forty-eight hours when they were placed with their long axes and embryo ends pointed towards the north magnetic pole than when pointed in any other direction.

When seeds of these same crops were placed between the facing poles of a large magnet and allowed to germinate, growth was best on those kernels that had their long axes pointed towards the magnet's poles.

Barley seed responded more readily and strongly in the experiments than did some of the other grains, and scientists at Lethbridge are now wondering whether kernel orientation has any effect on malt formation in barley or if the kernels are already so 'loaded' that it makes no difference.

In another investigation it was found that speed of germination and seedling growth of some varieties of wheat, corn, and beans were affected by exposing the normally dry or dormant seed to an introduced magnetic field before seeding. Again, the growth response of the plants was related to the orientation of the seed in relation to lines of magnetic force during pre-seeding treatment and germination. It was also related to the length of exposure time during the pre-seeding treatment. Wheat seeds that were properly orientated and exposed to an introduced magnetic field for 48 hours or for 144 hours, just prior to seeding, germinated more quickly and grew faster than those exposed for intermediate periods.



Seed of barley (left) and oats (right) with their embryo ends and long axes pointed to the magnetic north germinated more quickly than those placed in other positions

Books

The Physiology and Biochemistry of Herbicides. Edited by L. J. AUDUS. Academic Press. £5 10*s*.

This large and authoritative book was written primarily for scientists working on the development and use of new herbicides. In seventeen chapters, sixteen distinguished contributors from Europe and N. America survey present knowledge and current theories on the mode of action of selective herbicides, their behaviour in soil and plant tissues, and their effects on plant growth and development through the whole range from symptoms obvious to the naked eye to biochemical reactions within the plant cell.

Since interest in these subjects, particularly in their practical implications, extends beyond the research laboratory, all who are concerned with the intelligent use of herbicides will find it a rewarding book to study. Reasons why pre-emergence herbicides tend to give variable results are made clear in Dr. G. S. Hartley's account of soil-weather-plant-herbicide relationships. The role of soil micro-organisms in scavenging herbicidal residues is reviewed by Professor Audus, who includes a table showing the relative persistence of nineteen commonly used herbicides in soil.

Growth abnormalities induced by 'hormone' herbicides are well described and illustrated by Dr. Chr. J. Gorter and Dr. W. van der Zweep. Recent reports of increased yields and enhanced disease resistance obtained from sub-lethal doses of 2,4-D (plus trace elements to offset deleterious side effects) are summarized by Professor D. J. Wort.

In practice, the success of chemical weed control operations depends a lot on correctly timed application. Dr. E. Aberg shows how stage of growth, plant health, nutrient status and previous cultural history all affect the susceptibility of weed and crop plants to different herbicides. Dr. K. Holly contributes a most useful chapter on selectivity in relation to formulation and application methods. Professor R. L. Wain deals with the complementary aspect of selective action within the plant.

S.L.

Government and Agriculture: Public Policy in a Democratic Society. DALE HATHAWAY. Collier-Macmillan. 70*s*.

There is, in the United States, a chronic disequilibrium between agriculture and the rest of the national economy. Why is this? Why, Professor Hathaway asks, does the rise of agriculture output continue to outstrip population growth when those engaged in farming are progressively underpaid, both for their work and their capital investment, and when, *per capita*, food consumption is relatively static? What should or can be done to stabilize or increase farm incomes and so correct the imbalance?

Hathaway first considers what people want, and what they believe they are getting, from U.S. farm policy. Then, in Part II, he reviews recent research and thinking on the nature and causes of this disequilibrium.

He concludes that, in addition to inelastic demand, the main causes are rising technological efficiency, the competitive structure of farming, and too much 'asset fixity'. By this he means that, in contrast to much manufacturing industry, too many fixed resources are 'trapped' on the farm (land, buildings, manpower, tractors, fruit trees, fences, etc.) and cannot be readily taken out of farming and used elsewhere in the economy.

There follows an analysis of agricultural instability (which is decreasing in the U.S. but is part of the disequilibrium) and of the 'depressed areas' and 'depressed classes' in U.S. farming.

After these closely reasoned economic arguments (which are, however, fairly easy to follow) he moves to the political scene, and stresses the declining power of the farm bloc and the rising influence of commodity interests and political parties in determining U.S. agricultural policy.

Finally, he looks at ways and means of remedying the instability of U.S. farming. He concludes that the attempted remedies have often proved disastrous, but occasionally have been tolerable or promising. The basic problems remain unsolved.

Hathaway's analysis and description of the American agricultural dilemma is, perhaps, wordier than it need be. But it is accurate, enjoyable and, on the whole, readable. More explanations of economic concepts, more definitions of economic terms and more concrete nouns and verbs would have helped the non-economist reader.

But these are minor faults in an excellent work on a key problem of developed (and some undeveloped) countries. This is: How can we make full use of science and

technology (which raise the productivity of fixed assets) unless we can simultaneously find *either* markets for the added output *or* other uses for the redundant technical resources 'trapped' on the land?

A.N.D.

Wayside and Woodland Trees: A Guide to the Trees of Britain and Ireland. HERBERT L. EDLIN. Frederick Warne. 30*s.*

Edward Step's *Wayside and Woodland Trees* was first published in Frederick Warne's already famous 'Wayside' series in 1904, and there were twenty-six impressions before the new edition of 1940. Although Herbert Edlin makes it clear in the preface that, in revising the work, he found little need to alter the basic approach, it is perhaps a little ungracious to drop Step's name from the title page. For he was indeed an outstanding naturalist of the old school: wild flowers, insects, sea-shells came as easily under his ken as trees. He sought to collect and identify rather than to classify and so, after an introductory general section, thirty pages are occupied by 'keys to the trees'.

The first key is by leaf characters, and may be called the summer identification; the second is by twig and bud characters—winter and spring features. The majority are illustrated by simple line drawings, and there are no less than 175 full-page plates, a good proportion in colour and showing especially the whole tree or its bole.

Out of the 138 trees described, all native species are included, together with the chief trees introduced either for timber or for amenity planning. The balance is in favour of trees native to Britain or long-established here, so that the commonest forest tree, now the Sitka spruce, only gets sixteen lines. Of our favourite trees we are reminded that the large-leafed lime, horse-chestnut, sweet-chestnut, plane, sycamore, locust, laburnum, mulberry, walnut, many of the poplars and willows are all introduced. The yew, juniper and Scots pine are the only native conifers and receive full treatment. The native Scots pine became extinct in Ireland in 1866.

The book is full of those little details which only the true field naturalist would note. For example, we are reminded that the attractive berries of the wayfaring tree prove disappointing when gathered for decoration: they have a strong smell and soon rot to pulp. The berries of the guilder rose are sour, so that the birds leave them till they have exhausted more palatable supplies. Often Continental names of trees are given, together with notes on old English and country names. Altogether this is still the best book of its type and deserves the continued popularity.

L.D.S.

Report of the Research Committee on Toxic Chemicals. Agricultural Research Council. 2*s.* 6*d.*

The A.R.C.'s Research Committee on Toxic Chemicals was set up at the request of the Minister for Science in 1962 (Chairman: Professor A. C. Frazer). The terms of reference were to consider the whole field of research into the use of pesticide chemicals in agriculture and food storage, and to make recommendations for further research.

The Report indicates that whilst there are no serious gaps in the present research programme on the use of pesticides, there are certain aspects which might well repay intensified study. In particular, the Committee recommends that more extensive ecological studies should be undertaken to determine the effects of pesticides on wild life. There is a need, too, for toxicological studies to find out the significance of pesticide residues present in human tissues, animals, foodstuffs, soil and water. The Committee feels that more attention ought to be given to research on biological control methods, especially those using diseases of insects, since they may lead to a reduction in the amounts of pesticides that have to be used to control pests, although it is evident that the continued use of pesticides on a wide scale will still be necessary if agricultural production is to be maintained and expanded.

The Committee concludes that the most important requirement is to maintain and expand research on the development of safer, more selective, and less persistent pesticides. It will continue to keep under review all research in this field.

E.D.

Beef Cattle. Young Farmers' Club Booklet No. 34. PETER BUCKLER. Evans Bros. 3*s.*

This is the latest of an extensive list of publications issued for Young Farmers' Clubs. It is never easy to compile such a booklet for readers whose knowledge of the subject may vary widely. But the author has achieved a nice balance between the extremes of over-simplicity and excessive technical detail. For those who wish

to extend their reading, a useful list of more specialized books is given.

In the opening chapter the author discusses beef as a meat item, and very rightly points out that however good the beef itself may be, it can be ruined by bad cooking. Just how beef should be cooked is perhaps not a matter for a booklet on production problems, but it is nevertheless vital that Young Farmers should realize its importance.

Succeeding chapters deal with the breeds and crosses that can produce beef, the various systems of rearing—single-suckled, multiple-suckled, bucket feeding, and the store and fattening stages. Clubs, in their own programmes, might well discuss in greater detail the finer points of bucket rearing, for this is the system where losses are greatest and where most skill is needed.

If they happen to be in store rearing areas, they should pay attention to the technique of good marketing referred to on p. 29. As such cattle will invariably be sold through auction markets, a close study of the attractive presentation of animals will pay dividends. At present, it is far from satisfactory.

But whatever the form of production may be, the importance of 'stockmanship' is rightly stressed. It is not easy to define this term, but such points as regular feeding times, study of individual animal temperaments, gradual change of food, and peace and quiet, are some aspects of animal comfort. No club need ever be short of matters to discuss, for this booklet could well serve as a basis for discussion for innumerable meetings.

H.E.

Research, Science and Technology. 2*s.* 6*d.*

All credit to two 18-year olds, A. G. R. Birtwell and J. G. T. Thornton of Marlborough College, for the idea of producing this 94-page book. They call it 'information for science undergraduates and sixth formers', and it is indeed a careers guide which many students and teachers, to say nothing of harassed parents, will be glad to see.

It comprises thirteen articles, written by as many specialists, describing briefly the fields which await the aspiring entrant—in technology, pure science and education. The opportunities that exist in agriculture are summarized by Frank Garner, the Principal of the Royal Agricultural College, Cirencester, and how strongly does this modern industry beckon the young scientist today!

It is understood that the book is obtainable from W. H. Smith's and J. Wyman's, and that all profits from its sale are to be donated to OXFAM and Cancer Research.

E.D.

Portrait of the Lakes. NORMAN NICHOLSON. Robert Hale. 18*s.*

This is a poet's view of his native region—a book as rich and satisfying as a good plum pudding, served with a generous helping of rum butter. Yet it is never cloying, because Mr. Nicholson is a Cumbrian and therefore a realist. From the front of his house in Millom he looks out on the central fells—a skyline unsurpassed in England. Behind the house there is a very different scene—the cliffs of a slag bank and the chimney stacks of blast furnaces, with pitshafts and the spoil heap of an iron mine not far beyond.

Mr. Nicholson insists that a truthful portrait of the Lakes must include both these apparently incongruous views. For the rock that gives the district its landscape of mountain and fell, dale and crag, waterfall and lake, also yields the raw materials of industry—slate, iron ore and limestone, coal and anhydrite. And the people who live there are just as likely to be miners, quarrymen or steel workers as hill farmers and shepherds.

'To look at the scenery without trying to understand the rock is like listening to poetry in an unknown language. You hear the beauty but you miss the meaning.' Mr. Nicholson is a superlatively good interpreter. He is frank about the stubbornly unpicturesque aspects—describing the colliery landscape at the coast near Workington as one of 'almost Miltonic horror'. And he is lyrical about much more than the famous views so well-known to tourists.

He writes vividly about people and places: the district's characteristic rocks and the way they were shaped, long ago, by volcanic eruption, earthquake, inundation and glaciation; the people who, from prehistoric times, have lived in this remote region and left their marks there, visibly in stone, or intangibly in the speech and way of life of later generations; and the farms, forests, reservoirs, roads, villages and towns, as they have developed in recent times.

This is a most consoling book for those that love the Lakes but cannot, alas, live there, for in it the feel and smell of the place are magically distilled into words. Most emphatically this is a book to buy and cherish.

S.L.

Agricultural Chemicals Approval Scheme

Since the publication of the 1964 List, the following products have been approved:

INSECTICIDES

DICHLORVOS

An organo-phosphorus compound for the control of mushroom flies (and certain glasshouse pests, e.g., aphids, red spider mites, thrips and whiteflies).

Liquid Formulations

Nogos 50 E.C.—Ciba Laboratories Ltd.

FUNGICIDES

DINOCAP

Wettable Powder Formulations

Bugges A.M. 62 Fungicide—Bugges Insecticides Ltd.

ZIRAM

For the control of apple scab (post blossom) and pear scab.

Wettable Powder Formulations

Mi-Dox Fuclasin Ultra—Midox

HERBICIDES

2, 4-DB with MCPA

Potassium and Sodium Salt Formulations

Redlegor—J. D. Campbell & Sons Ltd.

DICHLORPROP

Potassium Salt Formulations

J.M.S. 2, 4-DP—J. M. Stokes Ltd.

Profarma Dichlorprop (2, 4-DP)—Profarma Ltd.

DINOSEB

Formulations in Oil

Atlas DNBP in Oil—Atlas Preservative Co. Ltd.

Haulmone—Universal Crop Protection Ltd.

As a result of the extension of the uses of the following product, its name has been altered from that appearing in the 1964 List of Approved Products:

Morto Potato Haulm Destroyer—to Morto (Murphy Chemical Co. Ltd.)

MCPB

Sodium Salt Formulations

Bugges MCPB Selective Weedkiller Concentrate—Bugges Insecticides Ltd.

MCPB with MCPA

Potassium and Sodium Salt Formulations

Bellmac Plus—J. C. Campbell & Sons Ltd.

MECOPROP with 2, 4-D

Amine Salt Formulations

Chipko 4—Chipman Chemical Co. Ltd.

MECOPROP with FENOPROP

Potassium and Sodium Salt Formulations

J.M.S. CMPP + 2, 4, 5-TP—J. M. Stokes Ltd.

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The Physiology and Biochemistry of HERBICIDES

Edited by L. J. AUDUS, *Department of Botany, Bedford College, University of London*

1964, xix+555 pp., 110s.

The explosive development of selective organic weedkillers since the war has brought a major revolution in agricultural and horticultural practices. The initial empirical approach to herbicide design and development has now been replaced by one based on physiological and biochemical studies. This book has been written to meet the needs of all those scientists engaged in the design, development and use of herbicides by presenting an up-to-date survey of our present knowledge of the ways in which herbicides act through and upon the biochemical and physiological systems of the plant.

This volume is written by a team composed of plant physiologists, plant biochemists, agronomists, chemists and physicists, all acknowledged experts in this extremely important new science of selective weed control.

Analytical Methods for Pesticides, Plant Growth Regulators, and Food Additives

Edited by GUNTER ZWEIG **IN FOUR VOLUMES**

Volume I, 1963, xiv+637 pp., 171s. 6d. Subscription price: 150s.

Subscription price valid on orders for the complete set received before publication of the last volume.

Volume I is divided into three sections which provide a comprehensive coverage of the present methods for the analysis of pesticides and food additives. The first section, devoted to principles, covers formulation analysis, residue analysis, analysis of intentional and incidental food additives, extraction and clean-up procedures, and toxicological testing methods. The second section presents general methods for which the contributors have selected examples from the fields of pesticides and food additives. The final section deals with general applications, including residue analysis in the food and dairy industries, pesticide analysis in meat products, and residue analysis in government laboratories.

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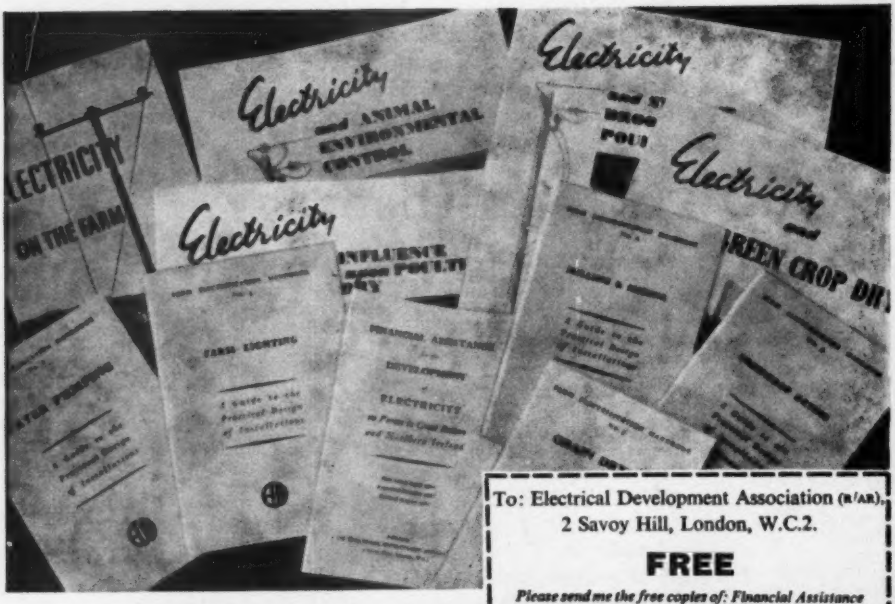

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